SPOLIA ZEYLANICA.

ISSUED BY

THE COLOMBO MUSEUM,

CEYLON.

VOLUME II.

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CONTENTS.

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GREGARIOUS CRUSTACEA FROM CEYLON.

By the Rev. THOMAS R. R. STEBBING, M.A., F.R.S.

With six Plates and one text-figure.

THE following paper was prepared in response to the request of my friend Dr. Arthur Willey, D.Sc., F.R.S., who sent me the group of specimens. Writing from the Colombo Museum in August, 1902, he says :—

"While collecting in a salt water lake having both fluviatile and marine connections I came across some piles of cocoanut driven into the water by fishermen, which harboured great numbers of small organisms, tubicolous amphipods and boring isopods, and in amongst the tubes several errant species, isopods, amphipods, and what I took to be tanaids, &c. I thought this was a very interesting example of association of animals, and it occurred to me to send samples of the specimens to you ..... I only obtained one specimen of the *Alpheus*, the one sent.

"The tubicolous amphipods were mostly on the inner surface of the bark stripped off the piles. The boring isopods were mostly above the water line. I cut off the top of the block and had it photographed and send copy. It looks like a bee or a wasp nest, each cell containing an isopod when fresh and several with young.

"The tubicolous amphipods (when they leave their tubes) move about with a straight motion like a caterpillar or grub. The errant amphipods which were amongst the tubes were dark gray in colour, and had the familiar sidelong motion. The tanaids crept out from the innermost recesses, often appearing to emerge from the tubes themselves.

"Some of the empty holes of the boring isopods at the top of the pile actually contained dipterous larvæ."

Appended was a list of the sorted specimens :—

"1. Twelve errant isopods, epizootic upon the colonies of boring isopods and tubicolous amphipods.

"2. Boring isopods.

"3. Tubicolous amphipods.

"4. Four crabs.

"5. Dark gray errant 'epizootic' amphipods.

"6. One blue-green alpheid.

"7. 'Epizootic' tanaids, with some gravid ♀."

The accompanying labels gave the locality as Lake Negombo. The collection proved upon examination to contain altogether ten species. In English waters a comparable society of crustaceans that penetrate the fibres of submarine timber includes the amphipod *Chelura terebrans*, Philippi ; the tanaid now known as *Tanais cavolinii*, Milne-Edwards ; and the isopod *Limnoria lignorum* (J. Rathke), with which others are from time to time found in company. Monsieur Chevreux has found no less than twenty-three species of amphipods residential upon the crab *Mamaia* squinado*, though probably nothing like that number on any one individual. To Dr. Willey's timber-haunting group I assign the following names :—No. 4, *Baruna socialis*, n.sp. ; No. 6, *Alpheus heterochelis*, Say ; No. 7, *Cyathura pusilla*, n.sp., accompanied by a single *Tanais philetœrus*, n.sp. another specimen of which occurred with No. 3 ; No. 1, *Cirolana willeyi*, n.sp., accompanied by a single specimen of *Corallana nodosa*, Schiödte and Meinert ; No. 2, *Sphœroma terebrans*, Bate, accompanied by specimens of the minute *Iais pubescens*, Dana ; No. 5, *Melita zeylanica*, n.sp. ; No. 3, *Corophium triœnonyx*, n.sp. The ten species accordingly represent ten genera, distributed over ten families in four principal divisions of the Malacostraca.

BRACHYURA.

CATOMETOPA.

Family : GRAPSIDÆ.

1886. *Grapsidæ*, Miers, Challenger Brachyura, Reports, vol. XVII., p. 252.

1900. Alcock, Journ. Asiatic Soc. Bengal, vol. LXIX., pt. 2, pp. 283, 389.

Alcock remarks that this family consists of "littoral (rock-haunting), or pelagic (drift weed- and timber-haunting), or estuarine and paludine, or fluviatile, or rarely terrene Catometopes."

* For explaining this change from a pre-occupied name use is being made of an opportunity more suitable than the present.

BARUNA, n.g.

Carapace broader than long, flattened, with short transverse median groove, front slightly depressed, antero-lateral margins tridentate. Third maxillipeds completely opercular, exopod broad but narrower than the third joint, which itself is narrower and shorter than the fourth, the connection between the two being angular between points at the same level ; the fifth joint, implanted at the middle of the somewhat irregular apical margin of the distally widened fourth joint, is also distally widened, and carries feathered setæ on its outer border ; enormously long feathered setæ proceed from the inner surface of the fourth and from the apices of the three following joints. Chelipeds of the male subequal, very large, with a gap between the closed fingers, the other legs hirsute on the back, the last pair the shortest. Pleon of seven segments in both sexes, in the female broad with densely hirsute margins, in the male with the last segment longest, subparallel-sided.

This genus appears to approach *Varuna* and *Pseudograpsus*, established by Milne-Edwards, and Stimpson's *Platygrapsus*, but in *Varuna* the third maxillipeds have the fourth joint smaller than the third, in *Pseudograpsus* (at least as defined by Miers) they have the exopod as broad or nearly as broad as the third joint, and in *Platygrapsus* the third joint meets the fourth in a singularly oblique line of junction. The definition of *Pseudograpsus* given by Milne-Edwards in 1837 would include the species about to be described, but it is evidently quite distinct from either *P. penicilliger* (Latreille) or *P. pallipes*, Milne-Edwards, the only two species referred to *Pseudograpsus* at its institution.

BARUNA SOCIALIS, n. sp.

Pl. 1A.

The carapace is punctate, apparently a little depressed transversely behind the front and at this part furry, some long hairs being distributed over other parts of the back. The front is a third of the extreme breadth. The antero-lateral margins are shorter than the postero-lateral, and are divided into three lobes, that nearest the orbit being the largest and subdivided into six or seven small teeth, the next into three or four, while the last is simple, rather a blunt tooth than a lobe. Both sexes have seven distinct segments in the pleon, which in the male narrows rather abruptly at the fifth segment, and has the last segment the longest, apically rounded. The pleon in the female is very broad, especially

in respect to the last four segments, densely fringed with long hairs which assist in retaining the very numerous eggs. The second antennæ are tipped with an elongate seta.

The first maxillipeds have the little process which De Haan appears to be describing in regard to his genera *Trichopus* (= *Varuna*) and *Eriocheir* by the words, in the first case, "laciniæ externæ lamella ex medio margine interiore producta, neque transversa, auctæ," and in the second with omission of the word "medio" and substitution of "ovata" for "neque transversa." In modern language this would be interpreted as a reduction of "the endopodite to a minute projection of the inner margin of the exopodite." The second maxillipeds have the penultimate joint densely lined with long setæ. The third pair have the peduncle of the exopod large, but not as broad as the third joint of the main stem. This in turn is neither so wide nor so long as the great fourth joint, which has the fifth joint inserted at the middle of its broad apical margin.

The chelipeds (or first peræopods) are very large in the male, subequal, with the inner distal margin of the wrist finely serrate, the hand very bulky, the thumb having two rows of fine denticles along its inner margin, receiving at its broad apex the point of the movable finger, which is similarly serrate, but also has a prominent stout tooth near the base. There is a large gap between the closed finger and thumb. In the female the chelipeds are quite small, and the small thumb and finger close their straight margins together without a gap. The second peræopods have the last four joints densely setose on the inner surface towards the outer margin, and the first of these joints furnished with unequal teeth or spines about the inner margin, the apex of which is acute in the wrist. The fifth peræopods are rather smaller than the three preceding pairs, but similarly hirsute.

The larger of the two male specimens was 7·4 mm. broad at the widest part of the carapace and 5·25 mm. long at the centre of it. The two females were both laden with eggs. In this sex the carapace was as long as that of the male, but not quite so broad.

The specific name alludes to the part taken by this little species in the group of crustaceans here under discussion.

MACRURA.

Family: ALPHEIDÆ.

1888. *Alpheidæ*, Bate, Challenger Macrura, Reports, vol. XXIV., p. 528.

1893. *Alpheidæ*, Stebbing, History of Crustacea, p. 230.

1899. *Alpheidæ*, Coutière, Ann. Sci. Nat., sér. 8, vol. IX.

1902. *Alpheidæ*, De Man, Kükenthal's Ergebnisse, Abh. Senckenb. Gesellschaft, vol. XXV., pt. 3, p. 861.

1903. *Alpheidæ*, G. M. Thomson, Trans. Linn. Soc. London, Zool., vol. VIII., pt. 11, p. 436.

ALPHEUS, Fabricius.

1798. *Alpheus*, Fabricius, Supplementum Ent. Syst., p. 404.

The species *Alpheus socialis*, Heller, as described and figured by Mr. G. M. Thomson in the work above-mentioned, shows remarkable variability in regard to the frontal portion of the carapace and the shape of the large cheliped. It is a question, however, whether the specimens examined may not have belonged to more than one species.

ALPHEUS HETEROCHELIS, Say.

1818. *Alpheus heterochelis*, Say, Journ. Acad. Nat. Sci. Philad., vol. I., p. 243.

1825. *Athanasus edwardsii*, Audouin, Explic. planches de Savigny, pl. 10, fig. 1.

1884. *Alpheus edwardsii*, Miers, Voyage of H.M.S. Alert, 1881–1882, p. 284.

1888. *Alpheus edwardsii*, Bate, Challenger Macrura, Reports, vol. XXIV., p. 542, pl. 97, fig. 1.

The solitary specimen obtained of this species was described by Dr. Willey as a blue-green *Alpheus*, taken among the tubes of the tubicolous amphipods at Lake Negombo. The blue-green tint on its arrival in England was no longer visible, the general colouring being quite pallid, but diversified by a large squarish patch of bright orange in the middle of the carapace, and a similar hue along the back of the pleon. The larger cheliped is on the left; both limbs are of a dusky orange, with a faint bluish line here and there. The length of the specimen is about 25 mm.

It cannot, I think, be distinguished from the species described by Miers in the reference given above, and the name here assigned to it really rests on his authority. Otherwise I should have been inclined to adopt for it the name *Alpheus avarus*, Fabricius, in agreement with Spence Bate's observation that "*Alpheus avarus*, Fabricius, appears to have no strongly marked features separating it from *Alpheus edwardsii*." But Miers,

while including in his long list of synonyms *Alpheus avarus*, De Haan, expressly distinguishes that species from the homonymous Fabrician species. That Miers gave the preference to Audouin's name over the earlier one by Say is obviously due to his error in dating Audouin's "Explication" in the year 1809. That date may apply to Savigny's unnamed figure, but the name was not given by Audouin till 1825, and was evidently unknown to Desmarest when he published his "Considérations générales sur les Crustacés" in that year. The synonymy given by Miers is criticized by Coutière in his valuable treatise on the *Alpheidæ* (p. 35), with the result that, apart from detailed description, the term *Alpheus edwardsii* (or its equivalent here adopted) becomes rather the designation of a group than the name of a species.

ISOPODA ANOMALA.

Family : TANAIDÆ.

1853. *Tanaidæ* (part), Dana, U. S. Expl. Exp., vol. XIII., p. 792.

1899. *Tanaidæ*, Norman, Ann. and Mag. Nat. Hist., ser. 7, vol. III., p. 332.

1900. *Tanaidæ*, Stebbing, Willey's Zoological Results, pt. 5, p. 613.

1901. *Tanaidæ*, H. Richardson, Proc., Washington Acad. Sci., vol. III., p. 565.

1902. *Tanaidæ*, H. Richardson, Trans. Connect. Acad. Sci., vol. XI., p. 278.

Under the head of the above references numerous others relating to this family will be found.

TANAIS, Milne-Edwards.

1828. *Tanais*, Milne-Edwards, Ann. Sci. Nat., sér. 1, vol. XIII., p. 288, and in Précis d'Entomologie par Audouin et Edw.

1840. *Tanais*, Milne-Edwards, Hist. Nat. Crust., vol. III., p. 141.

Other references are easy to find under those which deal with the family. The typical species *Tanais cavolinii*, Milne-Edwards, under the name *Tanais tomentosus*, Kröyer, is figured with admirable detail by Sars in the Crustacea of Norway, vol. II., pl. 5. According to Dollfus, the date of the Précis d'Entomologie is 1828, not 1829 as I have supposed in "Willey's Zoological Results." In addition to the species above-mentioned, in which the uropods

are three-jointed, as they are also in *T. stanfordi*, H. Richardson (1901), the genus contains the following species, in all of which the joints of the uropods are more than three :—

Tanais hirsutus, Beddard, with uropods	about 12-jointed,	established in	1886.
Tanais willemoësii, Studer, with uropods	8-jointed,	do.	1884.
Tanais alascensis, H. Richardson, with uropods	7-jointed,	do.	1899.
Tanais novæ-zealandiæ, G. M. Thomson	5-jointed,	do.	1880.
Tanais robustus, Moore, with uropods	4-jointed,	do.	1894.
Tanais grimaldii, Dollfus, with uropods	4-jointed,	do.	1897.
Tanais chevreuxi, Dollfus, with uropods	4-jointed,	do.	1898.
Tanais testudinicola, Dollfus, with uropods	4-jointed,	do.	1898.

TANAIS PHILETÆRUS, n. sp.

Pl. 2.

Among numerous examples of *Cyathura pusilla* there occurred a single example of this much smaller species, a female with a pair of small ovisacs attached beneath the fifth peræon segment. Its features will be most easily understood by comparison with those of the best known *Tanais*, *T. cavolinii*, which in general character the present species closely resembles, though it is considerably shorter and much more slender.

The cephalic segment is a good deal longer than broad, the front rounded, the eye-pieces acute in dorsal view, but in fact having rounded margins. The first two pleon segments have the dorsal fringe of plumose setæ. The telsonic segment has a produced bluntly triangular apex, with a pair of unequal setæ on each side at the base and an apical pair.

The two pairs of antennæ, the mandibles, and second maxillæ show no substantial differences from those in the earlier known species. The lower lip has the small process at the outer apex devoid of setules. The first maxillæ have the backward-bent "palp" ending in only two, not several, setæ. The maxillipeds in dissection came away in two halves as if not coalesced at the base, but as the epipods were lost, the dissection may have been a cause of disruption. The subsidiary plate, which reaches to the distal end of the ante-penultimate joint, appears to have a distal joint, process, or group of setæ, set on at right angles to its main stem ; but as this part in both members was clogged with obscuring material, I can only mention the appearance and figure it by conjecture.

The first gnathopods have the hand and finger somewhat more robust than in the female of *T. cavolinii*. It is in the male that these limbs are generally distinctive. The slender straight-fingered second gnathopods agree with those of the species just mentioned ; the first and second peræopods in the hand

and not uncinate finger approach the second gnathopods, but in the spiny armature of the ante-penultimate joint and the greater proportionate length of that which precedes it they are nearer to the three following pairs. These have the penultimate joint slightly curved and distally bulging, with the finger strongly hooked, but this hook is not, as it is in *T. cavolinii*, armed inside with a comb of denticles.

The pleopods differ in armature markedly from those of the species compared, for there the branch which is the smaller and attached to the upper part of the stem has its outer margin well fringed with setæ, whereas in the new species this margin has a single seta near the base. Both species alike have a little tooth-like spine at the apex of this branch.

The uropods are four-jointed. On one side the penultimate joint is decidedly the largest of the four, but its superiority in length is less marked in the other member of this pair of appendages.

The colour was light mottled brownish gray in spirit. The length from front of head to end of telson was 3 mm.

The specific name, from a Greek word meaning "lover of comrades," alludes to the discovery of this little animal in the great association of pile-dwellers which Dr. Willey has brought to light.

From other members of the genus which have four-jointed uropods the new species is readily distinguished. *T. robustus*, Moore, and *T. testudinicola*, Dollfus, have the pleon distinctly six-segmented, and the bands of setæ on the first two of those segments wanting or feebly represented. The second of these has the front of the head sharply produced. In *T. grimaldii*, Dollfus, the cephalic segment is almost (in the figure quite) as broad as long. In *T. chevreuxi*, Dollfus, the first joint of the uropods is decidedly the longest.

ISOPODA GENUINA.

Family: ANTHURIDÆ.

1814. *Anthuridæ*, Leach, Edinb. Encycl., vol. VII., p. 433.

1900. *Anthuridæ*, Stebbing, Willey's Zoological Results, pt. 5, p. 618.

1901. *Anthuridæ*, H. Richardson, Proc. U. S. Nat. Mus., vol. XXIII., pp. 505, 507.

1902. *Anthuridæ* H. Richardson, Trans. Connect., Acad. Sci., vol. XI., p. 284.

Under the second reference will be found a tolerably sufficient guide to the previous literature of the family.

CYATHURA, Norman and Stebbing.

1886. *Cyathura*, Norman and Stebbing, Trans. Zool. Soc. London, vol. XII., pt. 4, p. 121.

1900. *Cyathura*, Stebbing, Willey's Zoological Results, pt. 5, pp. 619, 620.

1901. *Cyathura*, H. Richardson, Proc. U. S. Nat. Mus., vol. XXIII., p. 508.

The relations of this genus to other genera in the same family are discussed in "Willey's Zoological Results," but the opinion there expressed, that in "the maxillipeds the epipod-bearing first joint always seems to be indistinguishably coalesced with the wall of the head," must be modified at least so far as regards the species now to be described. A genus *Colanthura*, in which the fifth peræopods are wanting, as in *Hyssura* and *Cruregens*, was established by Miss Richardson in 1902.

CYATHURA PUSILLA, n. sp.

Pl. 6B.

This species agrees in so many points with *Cyathura carinata* (Kröyer) that the description of that species by Kröyer, Harger, and others, when compared with the figures here given and the points of difference about to be mentioned, will cover all that is essential to be said.

In the present species no eyes could be detected. The sixth segment of the peræon, instead of being scarcely longer than the seventh, is as a rule very decidedly longer, and the longest males and the females laden with young do not exceed a length of 7·5 mm., whereas the length of *Cyathura carinata* reaches from 15 to 20 mm.

The distinct first joint of the maxillipeds might have been added as a specific character, but although Kröyer, Schiödte, Harger (in his text), and Norman and Stebbing all appear to be agreed as to the disappearance of this joint from *C. carinata*, Harger, in figuring the maxillipeds of that species (under the name *Anthura polita*, Stimpson), quite distinctly represents the missing joint. That so careful a writer as Harger should have left the discrepancy between his text and figure unexplained is difficult to understand, but the question remains open whether the connection between this joint and the large second one may not be open to individual variation. It is perhaps more probable that the joint, when missing, is in coalescence with the second joint than with the wall of the head.

The young ones, when ready for escape from the maternal pouch, are seen in the neatest possible longitudinal rows, each individual as straight as an arrow. At this stage the head is longer than the first segment of the peræon, instead of much shorter as in the adult. The seventh segment of the peræon is very short and totally devoid of limbs, which the other segments have almost of the full-grown character.

The name of the species refers to its comparatively small size.

Family : JANIRIDÆ.

1897. *Janiridæ*, Sars, Crustacea of Norway, vol. II., pt. 5, p. 98.

1900. *Janiridæ*, H. Richardson, American Naturalist, vol. XXXIV., p. 298.

1902. *Janiridæ*, H. Richardson, Trans. Connect. Acad. Sci., vol. XI., p. 294.

IAIS, Bovallius.

1886. *Iais*, Bovallius, Bihang K. Svenska Vet.-Akad. Handl., vol. XI., No. 15.

1900. *Iais*, Stebbing, Proc. Zool. Soc. London, p. 548.

IAIS PUBESCENS, Dana.

1853. *Jæra pubescens*, Dana, U. S. Expl. Exp., vol. XIII., p. 744, pl. 49, fig. 9.

1903. *Iais pubescens*, Stebbing, Proc. Zool. Soc. London, p. 549, pl. 38.

As this minute species was rather fully discussed under the second of the above references, it is scarcely necessary to add anything here, except to note its occurrence in association with yet another sphæromid. It was not actually observed upon *Sphæroma terebrans*, but was associated in the same tube with the specimens of that species.

Family : CIROLANIDÆ.

1880. *Cirolanidæ*, Harger, Rep. U. S. Comm. Fisheries for 1878, pt. 6, pp. 304, 376.

1890. *Cirolanidæ*, Hansen, Vid. Selsk. Skr., ser. 6, vol. III., pp. 275, 310, 317, 318.

1900. *Cirolanidæ*, Stebbing, Willey's Zoological Results, pt. 5, p. 628.

1902. *Cirolanidæ*, H. Richardson, Trans. Connecticut Acad. Sci., vol. XI., p. 289.

1902. *Cirolanidæ*, Stebbing, South African Crustacea, pt. 2, p. 49.

1904. *Cirolanidæ*, H. Richardson, Proc. U. S. Nat. Mus., vol. XXVII., p. 35.

Other references for the family and information upon it may be obtained from the above selection.

CIROLANA, Leach.

1818. *Cirolana*, Leach, Dict. Sci. Nat., vol. XII., p. 347.

1902. *Cirolana*, Dollfus, Bull. Soc. Zool., France, vol. XXVIII., p. 5.

Many other references for the genus will be found under those for the family. In regard to the last but one of these it may be convenient to mention that the species described by Ives in the Proc. Ac. Philad., p. 187, 1891, is *Cirolana mayana* (not *magara*), and that Miss H. Richardson's new genus is *Colopisthus* (not *Calopisthus*).

CIROLANA WILLEYI, n. sp.

Pl. 3.

The broadly convex front of the head has a small triangular rostrum between two slight depressions. The head's dorsal surface is smooth in the female, but in the male carries about five tubercles distributed in two rows. The segments of the peræon have each about eleven tubercles on the hind margin, those on the first three segments scarcely or not at all perceptible until the segments have been separated. The first, which is the largest, segment is tuberculate on the medio-dorsal surface in the male, but not in the female. Of the pleon the first segment is concealed and smooth, the second to the fifth have fewer but more conspicuous tubercles than the peræon segments, the median tubercle of the fifth segment forming a large tooth. The fifth segment is laterally completely overlapped by the fourth, and that again by the third. The telsonic segment is more or less triangular, incised near the base for the insertion of the peduncles of the uropods, the apex blunt, fringed with setules and eight spines, the dorsal surface carrying two little curved submedian ridges.

The eyes are dark, wide apart.

The first antennæ have the first two joints coalesced, the third rather longer than this combination, the flagellum of ten or twelve joints being scarcely as long as the peduncle.

The second antennæ fold back beyond the third peræon segment, with the many-jointed flagellum considerably longer than the peduncle, and furnished densely with setæ along the proximal half in the male, but not in the female. Both the male and female from which the figures are drawn happened to have the

antennæ unsymmetrical, the first antennæ of the female being so to a conspicuous degree, the second of the male having several more joints in the flagellum of one antenna than in that of the other.

The frontal lamina surmounting the epistome is pentagonal. The upper lip and mandibles do not sensibly differ from those of *Cirolana pleonastica*.* The first maxillæ have the usual three plumose setæ on the inner plate, the inner margin of which has a small projection. As shown by the figures, in the male the fourth joint of the maxillipeds is a little narrower than the fifth, whereas in the female it is a little broader. The vibratory lamina of the second joint in the female is of considerable size, of much greater length than breadth.

The first gnathopods are short and stout, the fourth joint fringed with six spines, which look as if worn down by use ; the fifth joint is almost completely overlapped by the fourth ; the sixth joint is characterized by a projection of the distal part of the inner margin, which carries two spines and some setules.

The second gnathopods have four spines on the inner margin of the third joint, eight or nine on that of the fourth, which also has an oblique row of spines on the distal part of the inner surface.

The peræopods are furnished with strong spines on the distal and inner margins of the third, fourth, and fifth joints, some but not all of these spines having the multifid structure noted by Schiödte and Meinert and by H. J. Hansen in some species of *Corallana* and *Excorallana*.

In the second pleopods of the male the masculine appendage is apically acute, reaching scarcely beyond the rami.

The uropods have the inner branch apically broad, rounded, serrate, with twelve spines in the serrations and numerous hairs, a longer tuft occupying one serration which has no spine. The much narrower outer branch has eight or nine spines on the outer margin, four or five on the inner, and a spine-like apex. This also is setose.

A specimen flattened out measured 8·75 mm. The colour in spirit is dark brown upon light, forming generally a symmetrical pattern, of which the darkest portion is in the dorsal centre of the fourth to the sixth peræon segments, to which follows a light piece shaped like a spearhead and reaching with its point to the base of the telsonic segment.

The species is named out of respect to the discoverer, Dr. Arthur Willey. From *Cirolana sculpta*, Milne-Edwards, found on the coast of Malabar, the present form is distinguished by having

* See Willey's Zoological Results, part 5, pl. 67A.

a large median tooth not on "the last segment of the abdomen," the telsonic segment, but on the preceding division of the pleon, as also by having all the segments of the peræon, instead of only the hinder ones, tuberculate. If we could suppose Milne-Edwards to have been deceived in regard to these particulars, there remains an important difference in the uropods, which in *C. sculpta* have the two branches nearly equal and both pointed, whereas in our species the inner is much the larger and broadly rounded. The length also of the form from Malabar is more than double of that from Ceylon.

Family : CORALLANIDÆ.

In their essay "De Cirolanis Ægas simulantibus," 1879, Schiödte and Meinert grouped together two new genera, *Barybrotes* and *Tachœa*, with Dana's *Corallana*. In 1890 H. J. Hansen assigned *Barybrotes* to a family Barybrotidæ, *Tachœa* along with two new genera, *Alcirona* and *Lanocira*, to a family Alcironidæ, and placed *Corallana* by itself in a family Corallanidæ. To the last genus he referred seven new species from the West Indies, and to these Miss Harriet Richardson in 1899 added an eighth species from California and in 1901 a ninth from Florida. Hansen records eleven species earlier than his own as with more or less probability belonging to the genus or at least to the family. Among these eleven stands *Corallana hirticauda*, Dana, with which the fortunes of both family and genus are bound up, since the genus was originally founded for this species alone. Recently I have had an opportunity of examining specimens of *Corallana hirsuta*. Schiödte and Meinert. As this is certainly in the most intimate alliance with Dana's species, the conviction is forced upon me that the nine species assigned to *Corallana* by Hansen and Richardson must be removed to a new genus *Excorallana*, to which Hansen's definition of *Corallana* applies, and that the six species of *Corallana* described by Schiödte and Meinert will properly remain in that genus, which, with *Alcirona*, *Lanocira*, and *Tachœa*, will form the family Corallanidæ. To this Hansen's definition of the Alcironidæ will apply, with the slight modification that the palp of the maxillipeds must be described not as four-jointed, but as four- or five-jointed.

Genus : CORALLANA, Dana.

1853. *Corallana*, Dana, U. S. Expl. Exp., vol. XIII., pp. 748, 773.

1879. *Corallana*, Schiödte and Meinert, Naturhist. Tidsskr., ser. 3, vol. XII., p. 286.

CORALLANA NODOSA,* Schiödte and Meinert.

1879. *Corallana nodosa*, Schiödte and Meinert, Naturhist. Tidsskr., ser. 3, vol. XII., p. 294, pl. 5, figs. 8, 9.

1890. *Corallana nodosa*, Hansen, Vid. Selsk. Skr., ser. 6, vol. III., p. 389.

Pl. 1B.

Among several examples of *Cirolana willeyi* there occurred a single specimen undoubtedly belonging to the form figured and described by Schiödte and Meinert as *Corallana nodosa*, mas adultus. They describe and figure also the femina ovigera and the virgo, but Hansen suspects that two or possibly three species have been grouped together under one designation. A single specimen does not lend itself to the discussion of that question. So far as the male is concerned the superficial characters are very unmistakable. The projecting lobe of the first joint of the upper antennæ attracts attention. The two little cephalic eminences between and slightly in advance of the eyes are indeed not shown in the figure which the collaborating authors supply, but they are well described in their text as a pair of short high carinæ with short sharp apex. The nodules on the last three segments of the peræon are, as they represent them, a large and small one close together on each side of the fifth and sixth segments, and on each side of the seventh a solitary large nodule.

The eyes are large, distinctly facetted.

The first joint of the upper antennæ, so remarkable by its upward curved lobe, no doubt represents two joints in coalescence, the following much shorter and narrower joint being the true third joint of the peduncle. The flagellum in our specimen consisted of thirteen unequal joints, none elongate. The much longer second antennæ had in one member of the pair a 17-jointed, in the other a 22-jointed, flagellum.

The mandibles are elongate, differing greatly from those of *Excorallana*, both in the apical part and in the palp, this having not the first but the second joint longest, as in the other true Corallanidæ. They agree in general structure with the mandibles of *Tachœa crassipes*, but the apical part, instead of being simple, has subsidiary teeth as in *Alcirona*. The spine-row is represented by a single spine.

The lower lip has each division apically bilobed, the lobes being approximately equal and very slightly separated.

The first maxillæ agree in much with those of *Tachœa crassipes* but quite as well with those of *Excorallana tricornis* (Hansen).

* On plate 1B this species is named *Tachœa nodosa* by error.

The second maxillæ are of delicate structure, tapering to a pointed apex.

The maxillipeds decisively remove this species from the Excorallanidæ, besides distinguishing it from *Alcirona* and *Lanocira* in its own family. The first joint is very small, the second fully as long as the remaining five joints combined. No one of these is very large, but the antepenultimate is the largest, exceeding the rest both in its breadth and length, which are subequal. The terminal joint is very small, but distinct. In *Tachæa crassipes* the original authorities for that species figure the maxillipeds, but leave it obscure whether they are representing a seventh joint or not. In Hansen's more precise figure there is no seventh joint, but a nodular cap to the sixth joint which may very well be the small seventh joint in coalescence. If this be the right interpretation, it will follow that the long second joint of the maxillipeds is simple, not the result of two joints coalesced.

The dilatation of the sixth joint of the limbs appears to be legitimately included among the generic characters of *Tachæa*, since the joint is not dilated either in *Alcirona* or *Lanocira* or in the known species of the present genus.

In the second pleopods the masculine appendage reached just to the extremity of the rami.

The telsonic segment is armed round the broad apex with fourteen spines and many plumose setæ.

The specimen, which was somewhat difficult to flatten for exact measurement, equalled about 8·5 mm. in length, with a breadth about half the length.

Its colour in spirit may be described as orange, lightly sprinkled with darker tree-markings.

Family : SPHÆROMIDÆ.

1847. *Sphæromidæ*, White, List of Crustacea in Brit. Mus., p. 102.

1900. *Sphæromidæ*, Stebbing, Willey's Zoological Results, pt. 5, p. 643.

1902. *Sphæromidæ*, Stebbing, South African Crustacea, pt. 2, p. 64.

1904. *Sphæromidæ*, H. Richardson, Proc. U. S. Nat. Mus., vol. XXVII., pp. 24, 38.

The last reference but one will give a key for finding others.

SPHÆROMA, Bosc.

1802. *Sphæroma*, Bosc., Hist. Nat. des Crustacés, vol. II., p. 182.

1900. *Sphæroma* (sensu restricto). Stebbing, Proc. Zool. Soc., London, p. 552.

The second of these references will supply a sufficient clue to the extensive literature of this genus in the wider acceptation.

SPHÆROMA TEREBRANS, Bate.

Pl. 4.

1866. *Sphæroma terebrans*, Bate, Annals and Magazine Nat. Hist., ser. 3, vol. XVII., p. 28, pl. 2, fig. 5.

1866. *Sphæroma vastator*, Bate, Annals and Magazine Nat. Hist., ser. 3, vol. XVII., p. 28, pl. 2, fig. 4.

1897. *Sphæroma destructor*, H. Richardson, Proc. Biol. Soc. Washington, vol. XI., p. 105, figs. in text.

Common sense continually justifies Bishop Butler's axiom that probability is the guide of life. But about the name and synonymy of the present species conflicting probabilities range themselves in a disturbing manner. There can be no doubt that an intimate relationship exists between—(1) *Sphæroma terebrans*, named by Fritz Müller, who procured it in Brazil from timber that had been immersed in the sea; (2) *Sphæroma vastator*, Bate; (3) *Sphæroma destructor*, Harriet Richardson; and (4) the form about to be described.

Bate's species was sent to him from Madras by Captain Mitchell, according to whom it was procured "from a piece of wood which had formed part of a railway bridge over one of the backwaters on the west coast of the Indian Peninsula. The wood was honeycombed with cylindrical holes, from about $\frac{1}{10}$ to $\frac{2}{10}$ of an inch in diameter, placed close together. In many of these holes the animal was rolled up like a ball."*

In Bate's description we may notice the following statements:—"The animal is of a long oval shape, without any distinct coxæ, and furnished with four longitudinal parallel rows of tubercles or blunt teeth on the three posterior somites of the pereion and the anterior portion of the pleon." "The superior antennæ have the first joint of the peduncle broader than the second, which is very short and round; the third is twice as long as the second, but much shorter than the first, and the flagellum gradually tapers to an obtuse point, and is formed of several articuli, of which the first is much the longest." The second antennæ are "perhaps slightly longer." "The mandibles are robust, and furnished with strong pointed incisor teeth as well as a powerful molar tubercle, between which exists a process armed with six or seven strong equal-lengthed serrated spines, which are probably used in the tearing down of the wood into which the animal burrows. The

* Annals and Magazine, *loc. cit.*, p. 30.

TOP OF COCOANUT PILE FROM NEGOMBO LAKE HONEYCOMBED BY "SPHÆROMA TEREBRANS."

[*To face p. 16*

secondary appendage to this organ is short and three-jointed; the third joint is the shortest, and is nearly as broad as long; it is ciliated upon the flexile margin with hairs, which gradually increase in length towards the apex of the appendage." The maxilliped "consists of five joints, of which the basal is longest and broadest, and carries the other four as an appendage." "The two pairs of gnathopoda and the first pair of pereiopoda resemble each other in form and size. They are slender and comparatively feeble appendages, and furnished on the anterior margin with long plumose hairs." "The coxa is fused with the dorsal portion of the somite, and forms an overhanging plate-like process." The second and third joints are long and slender, the third and fourth each furnished on the front margin with a thick row of plumose hairs, standing at right angles with the joint; the fourth joint is short, anteriorly produced to a point; the fifth and sixth joints are short, slender, with short cilia on each margin; the finger "short, curved, unguiculated, and armed with a small subapical tooth or secondary unguis." "The last four pairs of pereiopoda resemble each other in general form; they are very robust and strong, and are furnished on the anterior and posterior margins with rows of stout bushy hairs, which appear to increase in number and strength posteriorly, and some of which take a spinous character in the last two pairs, as on the distal extremity of the propodos, where they become spines with serrated margins." The uropods are marginal, consisting "of a single branch on a strong and fixed peduncle, which is produced to a point directed inwardly; to the under surface of this, near the middle, articulates the solitary ramus; this is slightly curved and produced to a pointed apex, and is furnished with five or six sharp teeth on the outer margin; the inner margin is smooth, and so is the inferior, both of which last are furnished with short fine cilia, in this offering perhaps the readiest distinguishable feature from the South American species, which has this appendage fringed with long and coarse hairs." The colour of the animal in spirit "was a subdued sage green." The length is about $\frac{1}{3}$ inch, and the breadth about half as much.

The specimens which Miss Harriet Richardson described in 1897 as *Sphæroma destructor* were "found boring the piers on St. John's river at Palatka, Florida." Their close resemblance in habits and appearance to the species described and figured by Bate is admitted, but differences are adduced under the four following heads: (1) "the number and arrangement of the tubercles;" (2) "the structure of the feet;" (3) "the upcurved margin of the posterior half of the terminal segment of the abdomen;" (4) "the presence of numerous tubercles furnished with bristle-like hairs upon the

abdomen." The third and fourth particulars, however, are only claimed as differences, because they are not mentioned in the description of *Sphæroma vastator*. But no inference can be drawn from the absence of mention to the absence of a character. Writers leave many points unmentioned from carelessness, for fear of being prolix, or through failing to observe them. The features here in question are not of the highest importance and in some specimens cannot easily be discerned. In the dorsal view of *Sphæroma destructor* itself they are not indicated.

Our knowledge of *Sphæroma terebrans* is derived from the figures which Bate gives of the uropod and the mandibular palp, and two comparative statements which those figures are designed to illustrate. He does not allege that the outer ramus of the uropod differs by its shape in the two species, but appeals to the "short fine cilia" in *S. vastator* as offering a ready contrast to the "long and coarse hairs" in *S. terebrans*. The small importance of such a distinction may be judged from the circumstance that Miss Richardson mentions neither the occurrence nor the absence of either cilia or hairs in this part of *S. destructor*. The remaining contrast is of a higher grade. To justify a discriminating name for the isopods from Madras, Bate says: "A close examination is required to distinguish a specific character separating these from the Brazilian specimens; and I think that the only one to be relied upon is that the pointed and hook-shaped termination of the appendage of the mandible in Müller's specimens is represented in those from Madras by a flat broad joint. I therefore think that, minor variations being taken into consideration, together with the distance of the two habitats, we do not err in considering the following a distinct species from that found by Fritz Müller." For *S. vastator* he figures a normal mandibular palp, fairly in agreement with what is found in the specimens from Ceylon and with the figure which Miss Richardson gives of this appendage in *S. destructor*. But for *S. terebrans* the figure exhibits a four-jointed palp, which can only be accepted by one who is willing to cry *credo, quia impossibile*. There cannot be the slightest doubt that the artist has been the victim of some ocular deception, "the pointed and hook-shaped termination" not being a joint at all, but merely the terminal spine or spines of the third joint, the true shape of which has been obscured by the angle at which it was viewed.

Passing now to the specimens from Ceylon, I find them in so close an agreement with the description and figures given by Miss Richardson for *S. destructor*, that they might certainly fall to that designation but for the high probability that *S. destructor*

is identical with *S. terebrans*. It would be singular to have the same wood-boring isopod in Florida and Ceylon, and an almost identical but distinct species in Brazil and Madras.

The sharp transverse ridge on the fourth segment of the peræon is worthy of notice. There are generally four pairs of submedian dorsal tubercles, successively on the sixth and seventh segments of the peræon, on the proximal sutured combination segment of the pleon and on the telsonic segment, the pair on the seventh pleon segment and the telsonic segment being flanked by another tubercle or tuft of setæ on either side. But there seems to be some variation, and a definite determination of the tubercles is made difficult by the colouring which is often dark and by the clogging of the pubescence with extraneous material. The side plates of the second and following peræon segments are distinct.

The eyes are dark and wide apart.

The first antennæ have a stout first joint which may represent the true first and second coalesced. The following joint is short, scarcely longer than broad. The next is sometimes regarded as the third of the peduncle, but may be the first of the flagellum. It is as long as the basal joint, and is followed by eight small unequal joints. The second antennæ have the last three joints of the peduncle subequal, the flagellum rather longer than the peduncle, tapering, of twelve to thirteen joints, many of them tufted.

The strongly projecting mandibles are well described by Bate, though it is not easy to agree with his supposition that the feeble little tuft of serrated spines is employed "in the tearing down of the wood into which the animal burrows." As Miss Richardson intimates, the projecting incisor tooth provides a suitable equipment for this destructive work. The first joint of the small palp is the longest.

The first maxillæ have the inner plate tipped with three strong plumose setæ and one that is feeble; on the outer plate there are nine spines, all or most of them denticulate. Of the second maxillæ the three plates are fringed along two-thirds of the inner margin, the armature of the innermost plate being very distinctly plumose.

The maxillipeds, which Bate speaks of as five-jointed, really have the full complement of seven joints, though the first and third are not very conspicuous. It should be noticed that these organs are built like those of *Sphæroma serratum*, but differ much from those in the genus *Exosphæroma*.

Mr. Bate and Miss Richardson agree in describing the first three pairs of trunk legs (the first and second gnathopods and first

peræopods) as being alike. Bate speaks of the fifth and sixth joints in these limbs as "short, slender;" Miss Richardson regards the same joints as "long and slender." But, to judge by the figure which the latter naturalist gives as "leg of first pair" (that is, the first gnathopod), the joints in question are long or short indifferently according to the standard of comparison, short compared with the second and third joints of the first three pairs of limbs, long compared with the homologous joints in the two following pairs. It is not, however, the case that the first three pairs of limbs are all alike. At least in the Ceylon specimens the first pair have the fifth joint extremely short, with the hind margin longer than the front, so that it *under-rides* the sixth joint. This differentiation of the first gnathopods is so habitual in the Sphæromidæ that its absence from the specimens collected in Brazil, Madras, and Florida is quite improbable. On the other hand, the general resemblance in the three pairs of slender limbs, with their striking armature of long setæ close-set in double rows, is very great, so that when detached from the body they may easily be confused.

The second and third peræopods are somewhat similar in pattern one to the other, but the second joint is longer and more slender in the third pair than in the second, and the third joint is larger in the second pair than in the third.

The fifth peræopods again resemble the fourth in pattern, but have all the joints except the finger more elongate. These pairs by their broad but laminar joints are strongly distinguished from the two preceding pairs, which are short and stout. They have a fringe of serrated spines on the apex of the fifth joint, which Bate transfers to the sixth joint, though his figure pretty clearly shows that he meant the fifth. He also says that the last four pairs of limbs "resemble each other in general form," which is quite contrary to the fact in the Ceylon specimens, and, to judge by his figures, also in those from Madras.

The pleopods are satisfactorily described by Bate. To the uropods he allots a single branch, but it is quite clear that what he speaks of as the produced part of the peduncle is the inner branch in coalescence. The articulated outer branch has, he says, five or six teeth on the outer margin. This agrees with the Ceylon specimen figured herewith, the teeth being in fact spines, six in number if the apical one be included. Miss Richardson mentions four teeth on the outer edge, but as this number is also found in the Ceylon specimens, the precise number is immaterial.

The colour, which Bate gives as sage green, and Miss Richardson as "a dark brown, shaded on the edges with a lighter brown," is in

the Ceylon specimens in various tints of mottled brown or gray, the margins light. The light margins have sometimes points of orange, producing a deceptive appearance of tubercles.

The length of the large specimens is from 7·5 to 8 mm., with a breadth half the length. The proportion of the pleon to the rest of the body is not nearly so great as depicted in Bate's dorsal view of the animal.

Since Bate supplies no trustworthy distinction between *S. terebrans* and *S. vastator*, and since both in the "Annals and Magazine" and subsequently in the "Zoological Record" he gives what is called page precedence to *S. terebrans*, that appears to be the name deserving adoption. It was chosen indeed by Fritz Müller, but as the description was given by Spence Bate, he must be recognized as the authority, and in this instance it will be seen from the foregoing discussion that the personal equation counts for much.

Sphæroma verrucauda, White, from the accounts of Dana and Miers, appears to have some affinity with this species, but though found in rotten wood, the cavities were bored by *Teredo*. It has also been found in sandstone, the hollows of which it is not likely to have produced. *Sphæroma felix*, Lanchester, described from the "Skeat" expedition to the Malay Peninsula (Proc. Zool. Soc. London, 1902, p. 379), shows also a rather near agreement, but there the outer ramus of the uropod has eight small teeth on the outer margin.

AMPHIPODA.

GAMMARIDEA.

Family : GAMMARIDÆ.

MELITA, Leach.

1813. *Melita*, Leach, Edinb. Encycl., vol. VII., p. 403.

1853. *Melita*, Dana, U.S. Expl. Exp., vol. XIII., pp. 911, 962.

1862. *Melita*, Bate, Catal. Brit. Mus. Amph., p. 181.

1888. *Melita*, Stebbing, Challenger Amphipoda, Reports, vol. XXIX., pp. 263, 1710.

1893. *Melita*, Della Valle, Gammarini, Fauna und Flora des Golfes von Neapel., mon. 20, p. 707.

1894. *Melita*, Sars, Crustacea of Norway, vol. I., pt. 23, p. 507.

1900. *Melita*, Chevreux, Amphipodes de l' Hirondelle, p. 78.

The genus was originally founded upon *Melita palmata*, Montagu. Dana rashly made it part of the generic character that the upper antennæ were without an accessory appendage, though confessing that he was still in doubt whether in Montagu's species they had one or not. With equal rashness Bate transferred

Dana's *Melita tenuicornis*, in which the third uropods were supposed to have only one branch, to *Mœra*, in which the two branches are undoubtedly both well developed. Miers in 1875 founded a genus *Paramœra* for a species supposed to have uniramous uropods, but in which he subsequently found that they were biramous. This species he transferred to *Atylus*, while retaining the genus for *Melita tenuicornis*. In 1878, however, G. M. Thomson stated that this New Zealand species, of which he claimed to have examined perfect specimens, "must be replaced in the genus proposed by its original describer, Dana, viz., *Melita*." The conclusion rests on the supposition that Dana overlooked the secondary appendage of the antennæ and the small inner ramus of the uropods. It is by no means an improbable conclusion, although Dana's specimens from the Bay of Islands were "found along the shores between high and low water level," whereas Thomson's "were taken in the Taieri river in fresh water, but they had probably come up with the tide, which is felt 15 miles from the mouth." (Trans. New Zealand Inst., vol. XI., p. 241). The case is somewhat complicated by the circumstance that Dana describes as *female?* the form which has second gnathopods characteristic of a male and figures for the *male* gnathopods of a shape to be expected in the female. In the latter form the third uropods were broken off. Professor Della Valle in 1893 enters *Melita tenuicornis* as one of the synonyms of *M. palmata*, but without discussing the absence of a feature conspicuous in the latter species, namely, the medio-dorsal tooth on the fourth pleon segment. Dana had previously established two species in the Proc. Amer. Acad. Sci., vol. II., pp. 214, 215, on the earlier page naming *Amphitoe* (*Melita*) *inæquistylis* for the supposed female, but, as I think, true male, and on the later page *Amphitoe* (*Melita*) *tenuicornis* for the other sex. If the two sexes belong together, the rule of page precedence will make the name *Melita inæquistylis*.

MELITA ZEYLANICA, n. sp.

Pl. 5.

Body compressed, segments smooth, except that the short fifth segment of the pleon is a little medio-dorsally notched and carries some small inconspicuous spinules. In the female the side plates of the sixth peræon segment are hooked as in *Melita palmata*, but less strongly.

The eyes are round, dark, rather small.

The first antennæ have the long second joint a little longer than the first and fully twice the length of the third, the flagellum of about twenty joints in the male and fourteen in the female, the

latter in the specimen examined with accessory flagellum of three joints, the former having this appendage four-jointed. It is only to the female that Dana's name *tenuicornis* would be applicable.

Second antennæ with gland-cone strongly produced, acute, fourth and fifth joints subequal, or sometimes the fifth the shorter, elongate in the male, the flagellum about eight-jointed, the first joint (especially in the male) much the longest, the end joints in that sex almost abruptly narrower.

Upper lip with distal margin evenly rounded.

Mandibles with slight quinquedentate cutting edge, secondary plate with four teeth on the left mandible, laminar and scarcely dentate on the right, spine row on left with four, on right with three spines, molar powerful with small lateral plate; palp with third joint as long as second, neither densely fringed.

First maxillæ with five setæ on broad apex of inner plate, palp with short first joint, the second long, carrying spine teeth and setules at the apex and overtopping the inner plate. In Dana's figures of these maxillæ for both sexes of *M. inæquistylis* the first joint of the palp is two-thirds the length of the second.

Second maxillæ. Inner plate having a dozen setæ on inner margin. Dana's figures show only three.

Maxillipeds narrow, both inner and outer plates carrying numerous spines, the outer plates much overtopped by the long second joint of the palp, its third joint distally widened and apically fringed, the fourth finger-like, the whole agreeing well with Dana's figure.

The first gnathopods of the male have the hind margin of the fourth joint densely furred, the fifth joint considerably longer than the sixth, beset on both margins and inner surface with numerous groups of spine-like setæ, the sixth joint similarly but less densely setose, oblong, with the finger attached at the middle of the apex as in Dana's figure of the *male*, its thin distal part resting on a slightly convex setulose palm margin. In the female there is less difference in length between fifth and sixth joints, and the finger is normally attached at the front of the apex, not at the middle as in Dana's *female*.

The second gnathopods in the male are very large, the fifth joint cup-like, with seven groups of setæ about the hind margin, the sixth joint massive, oblong, not distally widened as in *Melita palmata*, with the outer surface smooth, but inner surface and hind margin densely setiferous, the strong finger half the length of the sixth joint over the distally rounded hind margin of which it closes, past a smooth tract of the inner surface to a strong recumbent ridge near the middle of that surface. In the female

there is no such ridge, the hand is comparatively insignificant, not greatly longer than its breadth, with a very oblique palm, the end of which is not reached by the finger, the tip of that joint closing against a palmar spine a little within the margin on the inner surface of the sixth joint.

The endeavour to reconcile the Ceylon specimens with Dana's species broke down under the comparison of the gnathopods with his figures and descriptions. It was possible to suppose that Dana had inadvertently transposed the sexes. But in speaking of his supposed female specimen he says, "Hand of second pair of moderate size, long obovate, apex sparingly oblique, finger short, shutting against lateral surface of hand," and subsequently he says "the hand is naked." Of the supposed male he says, "Hand of second pair oblong, sub-elliptical, back much flattened, densely hirsute below, palm not excavate, finger rather large," and subsequently, "Hand of second pair about twice longer than broad." According to his figures also the hand of the second gnathopod in the supposed female is quite small compared with that of the supposed male. But in the Ceylon form, just as in *Melita palmata*, it is the male that has the finger of the second gnathopod shutting against the surface of the hand, and it is these male gnathopods that are enormously larger than those of the female and much more hirsute.

The first and second peræopods are slender in both sexes, and in the female the three following pairs are not stout, but in the male they are decidedly robust, the fourth joint especially being much broader than the two following, all three being spinose. This robustness is not indicated in Dana's figure of either sex. The finger is short, robust, with fine upward curved apex. The sixth joint of the fifth peræopod is usually longer than that in the limb which happened to sit for its portrait.

The inner branch of the third uropods is a little oval plate, flattened on one side, and carrying a spine at one corner.

The small telson consists of two quite separated plates, which taper each to a blunt apex, the sides carrying four spines or spinules.

The length of the male, not counting the antennæ, is 7·5 mm.

The colour in spirit is a light greenish brown, with a darker transverse stripe along the hind margin of each segment.

The specific name refers to the place of capture. Though the suspicion may linger that Dana had before him this very species, or one closely allied to it, his name could only be applied on the supposition that under stress of circumstances he misrepresented by pen or pencil almost every one of its salient features.

Family : COROPHIIDÆ.

COROPHIUM, Latreille.

1806. *Corophium*, Latreille, Genera Crustaceorum, vol. I., p. 58.

1888. *Corophium*, Stebbing, Challenger Amphipoda, Reports, vol. XXIX., pp. 79, 1670.

1893. *Corophium*, Della Valle, Gammarini, p. 362.

1894. *Corophium*, Sars, Crustacea of Norway, vol. I., pt. 27, p. 612.

1900. *Corophium*, Chevreux, Amphipodes de l'Hirondelle, p. 109.

The species now known of this genus are rather numerous, all possessing in common marked features of general resemblance, yet separable into two groups by the circumstance that in some the fourth, fifth, and sixth segments of the pleon are distinct, and in others consolidated into a single piece.

COROPHIUM TRIÆNONYX, n. sp.

Pl. 6A.

The rostral point is little produced. The side plates of the first peræon segment are apically fringed with six plumose setæ. The pleon is fully segmented, and has the lateral margins of the first two segments fringed with plumose setæ.

The eyes are small and dark.

The first antennæ have the flagellum shorter than the peduncle, about twelve-jointed in the male and nine-jointed in the female. In the latter the third joint of the peduncle is half as long as the second, and the second half the first, but in the male the third is less than half the second, and the second more than half the third.

The second antennæ are robust, in the male strongly setose, with the penultimate joint of the peduncle produced into a large curved tooth, with a small one beside it at the base on the inner side ; in the female this joint is as usual much shorter, furnished with numerous spines, but without teeth.

In the mouth organs it may be noticed that the narrow inner plates of the maxillipeds are fringed with spines, fifteen in number, along the whole inner margin.

The first gnathopods are of the usual pattern, with the third and fifth joints densely setose, the fifth tapering distally, the shorter oblong sixth fully as wide at the rounded spinulose palm as at the base, its front margin fringed with slender spines ; the finger smooth, small, curved, acute.

The second gnathopods have the fourth joint fringed with the customary double row of extremely long setæ, the boundary line between it and the fifth joint clearly marked, the sixth joint narrowly oblong with a slight curve, a slightly oblique series of long setæ fringing it near the base; the short robust finger is tridentate, the teeth not recumbent as in *Corophium acherusicum*, Costa, but upturned, the third being the largest and forming the unguis.

The peræopods show no characters distinguishing them from those of *Corophium volutator*, Pallas, as figured by Sars, except that in the first and second pairs the fifth joint is not longer than broad.

The pleopods have two coupling spines at the inner angle of the broad peduncle. The third uropods have the small oval setose ramus subequal in length to the somewhat stouter peduncle.

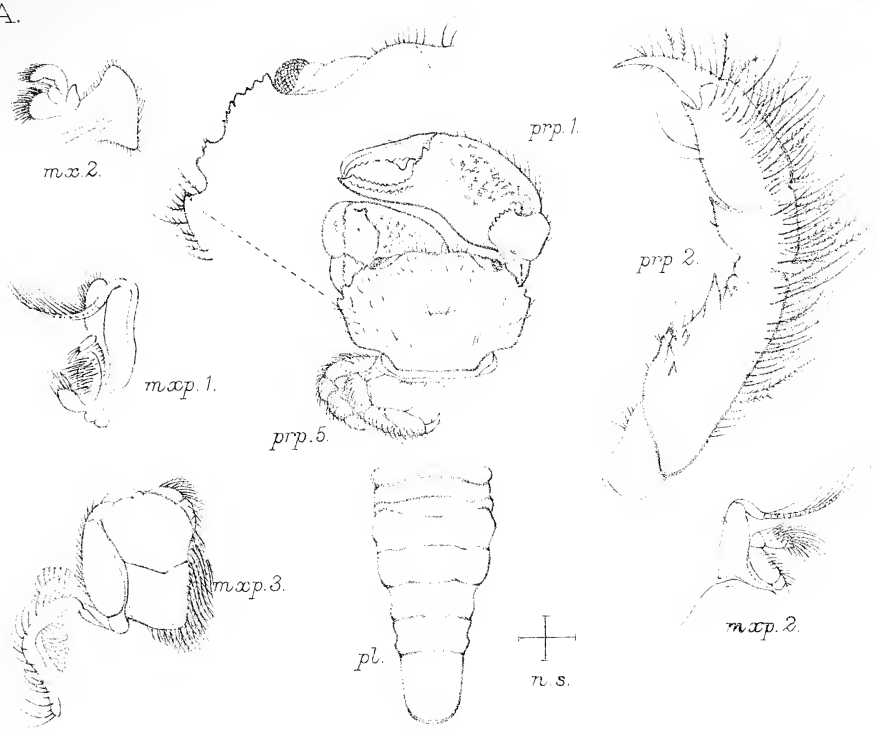
The telson, which is broader than long, apically rounded, has a tubercular widening at each corner of the base.

The colour in spirit is a light mottled brownish gray, the eyes occupying the extremities of a narrow black band on the front of the head, the limbs of trunk and pleopods colourless.

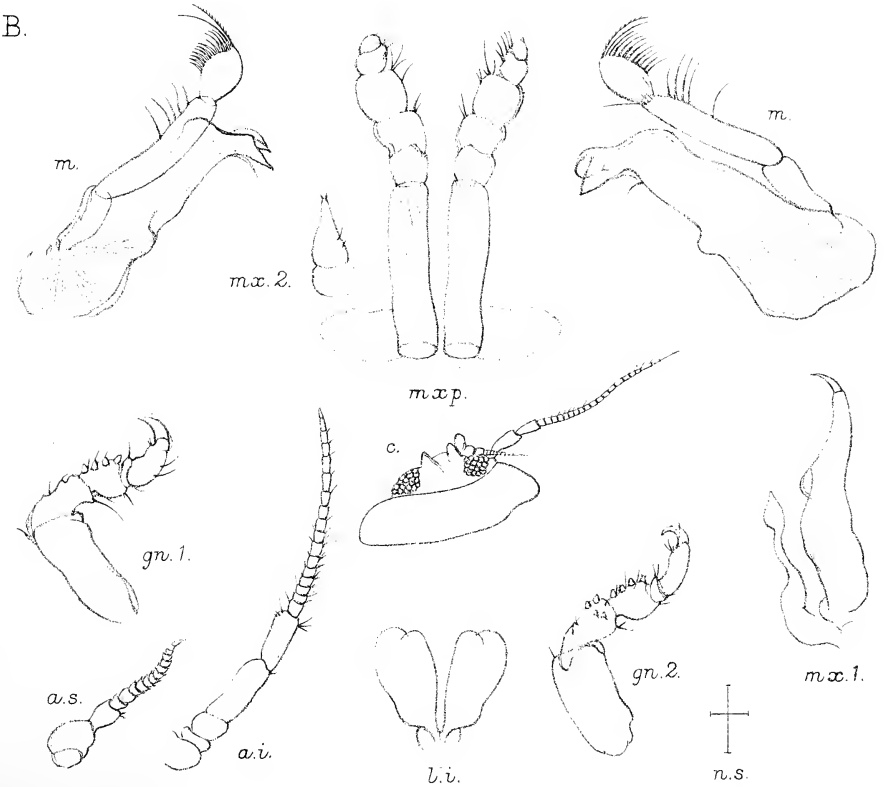
Some of the specimens at full stretch, a position they do not easily assume, measured, antennæ included, about 5 mm.

The specific name alludes to the trident-like finger of the second gnathopods.

A.

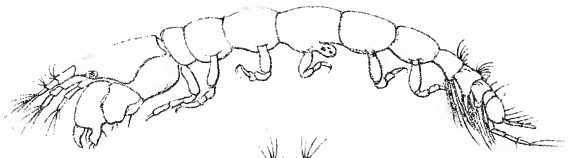


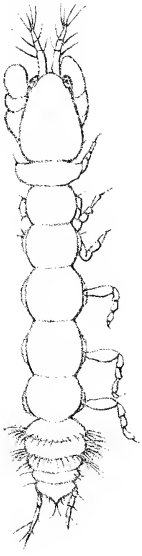
B.

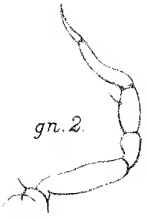


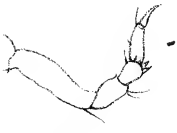
T.R.R.Stebbing del. West, Newman lith.

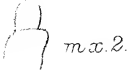
A. BARUNA SOCIALIS, *n. sp.* B. TACHÆA NODOSA, *(Schn. & Meir.)*

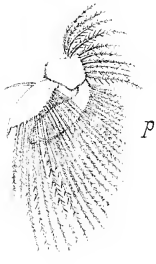


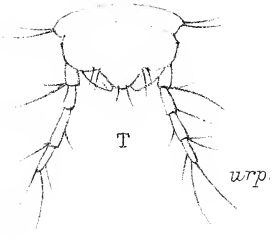


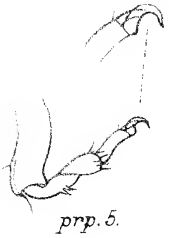






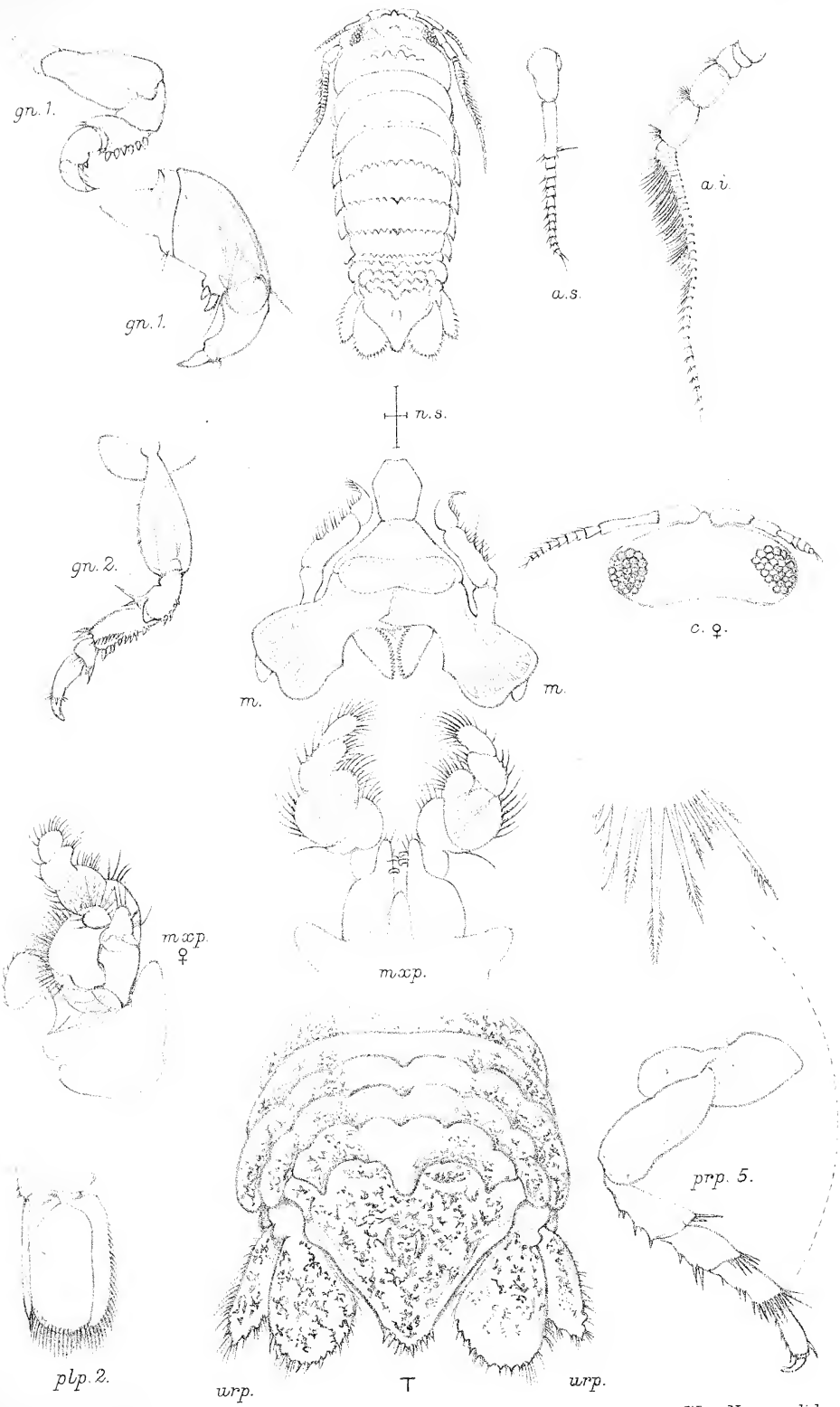






T.R.R. Stebbing del. West, Newman lith.

TANAIS PHILETÆRUS, *n. sp.*



T.R.R.Stebbing del. West, Newman lith.

CIROLANA WILLEYI, *n. sp.*

EXPLANATION OF PLATES.

Plate 1A.

Baruna socialis, n. sp.

n.s.—Natural size of carapace in specimen figured at the top of the plate, indicated by lines showing the greatest length and breadth.

prp. 1.—Chaliped or first peræopod in position.

prp. 2.—Second trunk leg or peræopod of the same specimen. The following figures are drawn from a smaller specimen, also a male.

mx. 2.—Second maxilla.

mxp. 1, 2, 3.—First, second, and third maxillipeds.

Pl.—The pleon.

Plate 1B.

*Corallana** *nodosa*, Schiödte and Meinert.

n.s.—Lines indicating the natural size of the specimen examined.

C.—Cephalon, with first segment of peræon, viewed a little sideways to show the prominences; first and second antennæ on the left side removed.

a.s., *a.i.*—First and second antennæ.

l.i.—Lower lip.

m.m.—The mandibles.

mx. 1, *mx.* 2.—The first and second maxillæ.

mxp.—The maxillipeds.

gn. 1, 2.—The first and second gnathopods.

Plate 2.

Tanais philetærus, n. sp.

n.s.—Line showing length of specimen figured above in lateral and in dorsal view.

a.s., *a.i.*—The first and second antennæ.

m.—Mandible.

l.i.—Lower lip.

mx. 1, *mx.* 2.—First and second maxillæ.

mxp.—Maxillipeds. One from the outer, one from the inner side

gn. 1, *gn.* 2.—First and second gnathopods.

prp. 1, 3, 5.—First, third, and fifth peræopods.

plp. 2.—Second pleopod.

T. urp.—End of pleon with the uropods.

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* See footnote on page 14.

Plate 3.

Cirolana willeyi, n. sp.

n.s.—Lines indicating natural size of male specimen figured above.

T. urp.—Pleon much more highly magnified.

a.s., *a.i.*—First and second antennæ.

m.m.—Mandibles in position as seen from below, with upper lip, epistome, and frontal lamina.

mxp.—Maxillipeds.

gn. 1, *gn.* 2.—First and second gnathopods, with part of first gnathopod more highly magnified.

prp. 5.—Fifth peræopod with some of the spines highly magnified.

plp. 2.—Second pleopods. These and the preceding details all drawn from the male.

C. ♀—Cephalon, with first antennæ of female.

mxp. ♀—Maxillipeds of female.

Plate 4.

Sphæroma terebrans, Bate.

n.s.—Lines indicating natural size of specimen, figured in dorsal view above, and in lateral view below.

Pl.—Pleon much more highly magnified.

a.s., *a.i.*—First and second antennæ.

m.—Mandible.

l.i.—Lower lip.

mx. 1.—First maxilla.

mxp.—Maxillipeds from inner surface, and one from outer surface.

gn. 1.—First gnathopod.

prp. 1, 2, 3, 4, 5.—The five peræopods.

Plate 5.

Melita zeylanica, n. sp.

n.s.—Line indicating natural size of male specimen figured above.

a.s., *a.i.*—First and second antennæ, flagellum of first incomplete.

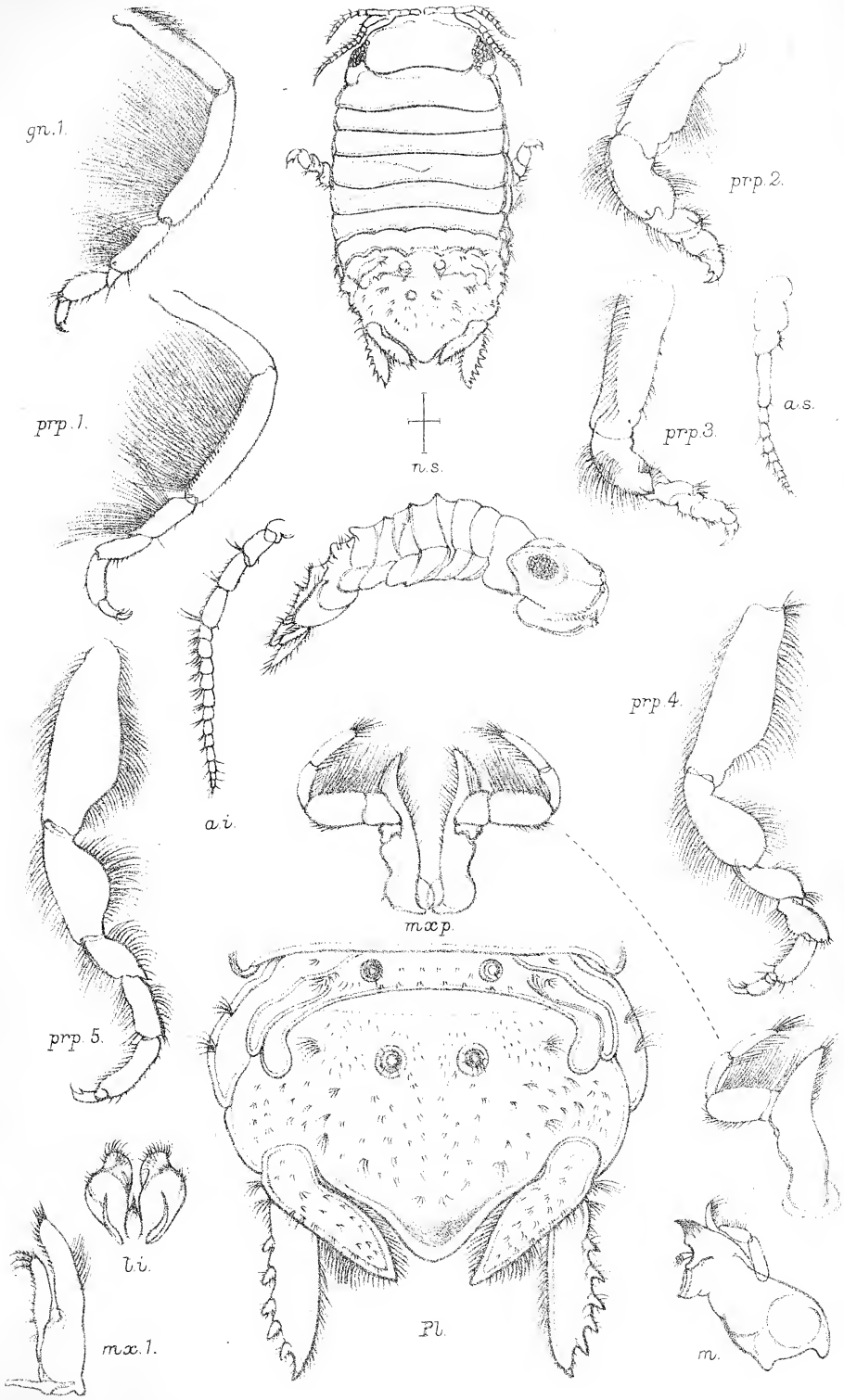
m.m.—Mandibles.

l.s., *l.i.*—Upper and lower lip.

mx. 1, *mx.* 2.—First and second maxillæ.

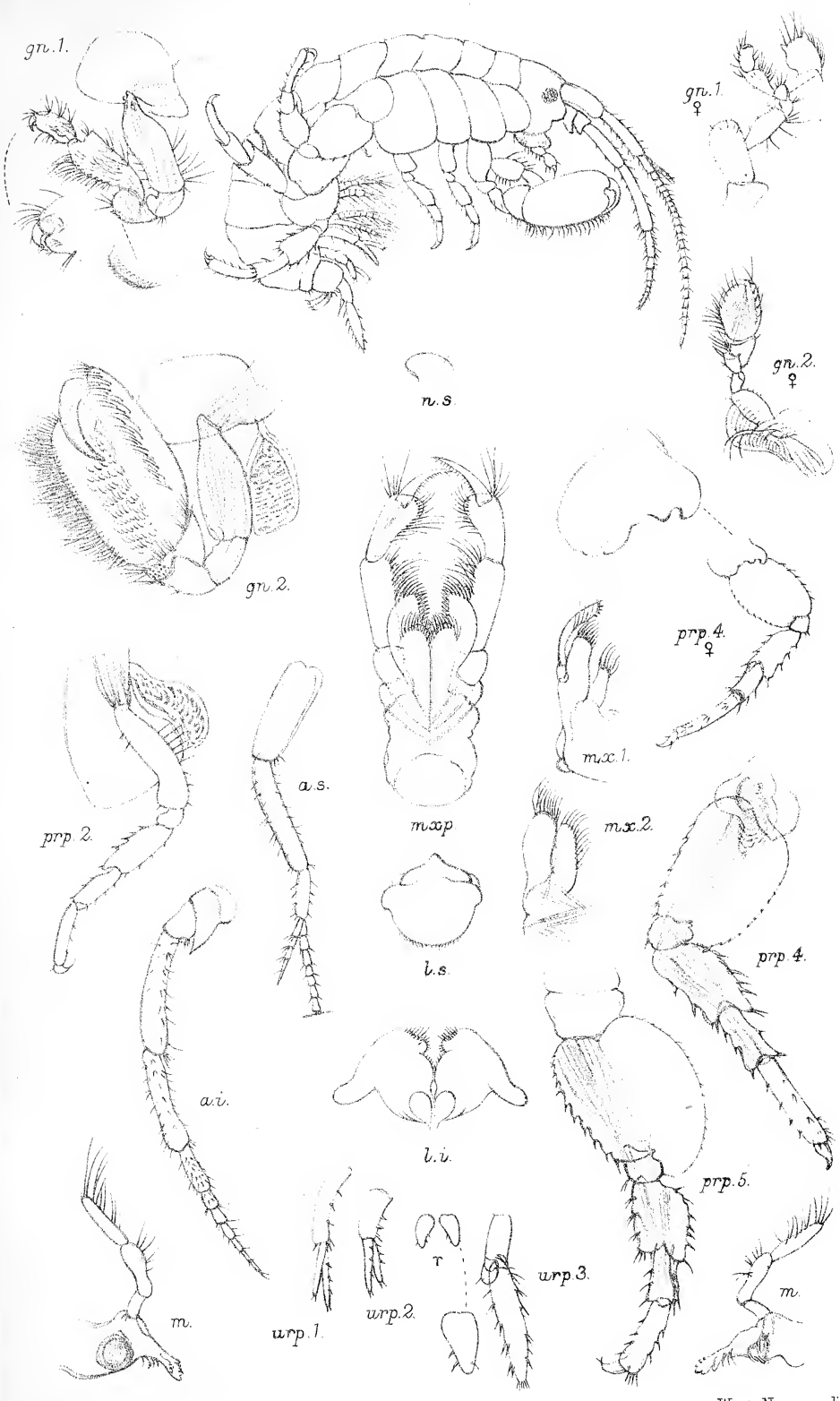
mxp.—Maxillipeds.

gn. 1, *gn.* 2.—First and second gnathopods, with parts of first more highly magnified.



T.R.R.Stebbing del. West, Newman lith.

SPHÆROMA TEREBRANS, *Bate.*

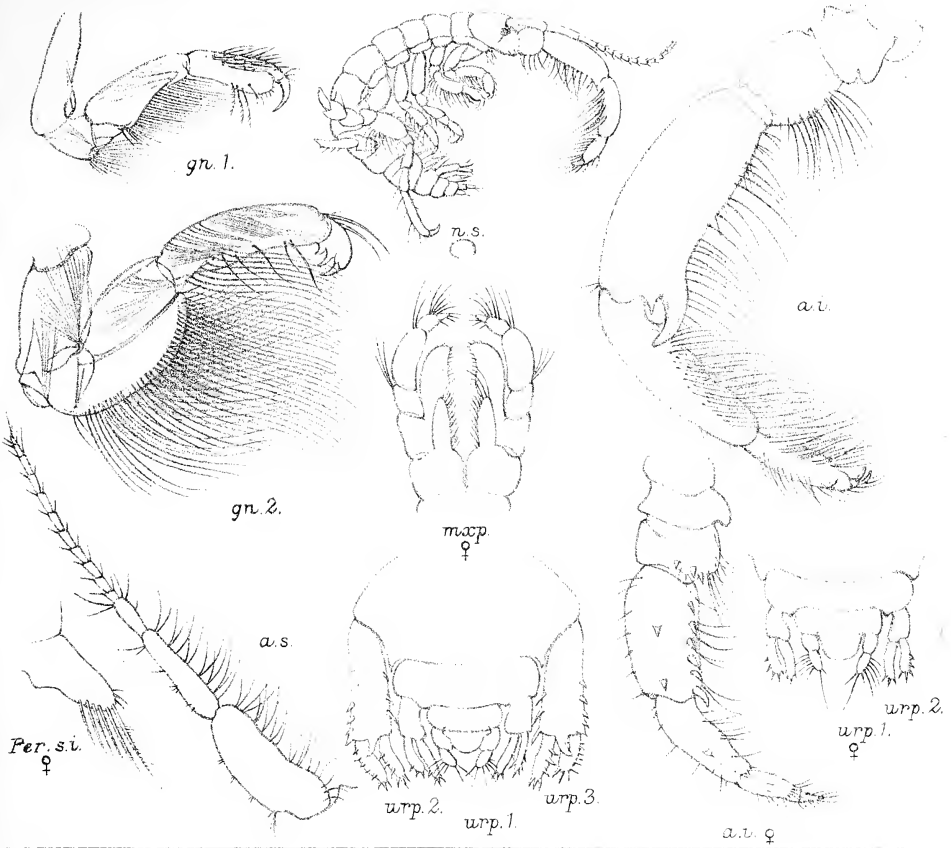


T.R.R. Stebbing del.

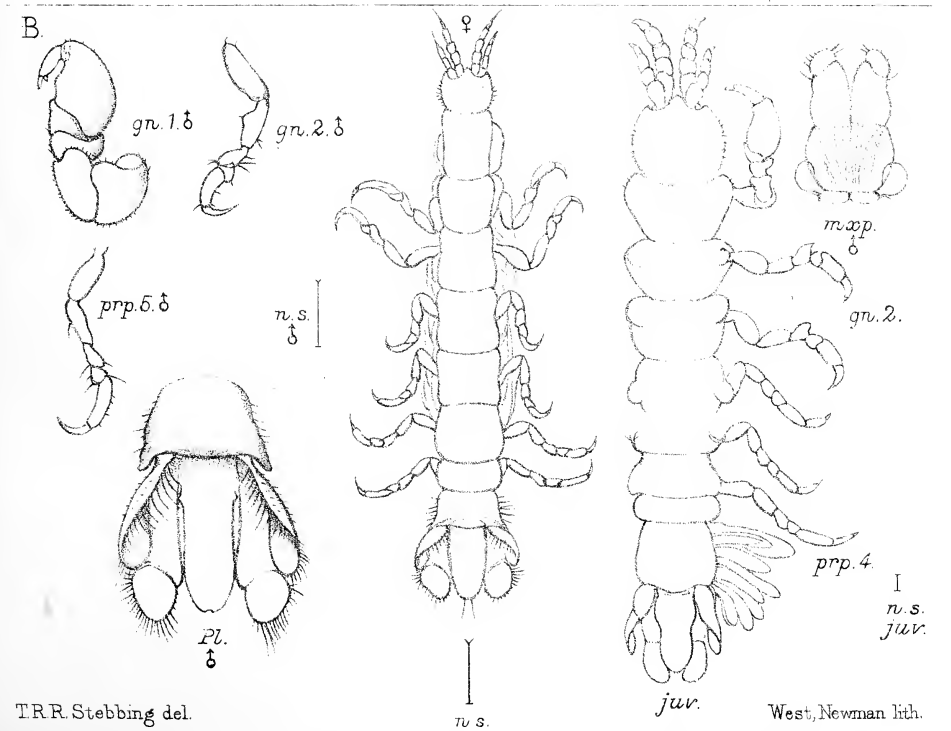
West, Newman lith.

MELITA ZEYLANICA, *n. sp.*

A.



B.



T.R.R. Stebbing del. West, Newman lith.

A. COROPHIUM TRIÆNONYX, *n.sp.* B. CYATHURA PUSILLA, *n.sp.*

prp. 2, 4, 5.—Second, fourth, and fifth peræopods.

urp. 1, 2, 3.—First, second, and third uropods.

T.—Telson, this and the preceding details being from a male specimen.

gn. 1 ♀, *gn.* 2 ♀—First and second gnathopods of the female.

prp. 4. ♀—Fourth peræopod of female, with the side plate more highly magnified.

Plate 6A.

Corophium tricænonyx, n. sp.

n.s.—Line indicating natural size of male specimen figured above.

urp. 1, 2, 3.—Pleon much more highly magnified.

a.s., *a.i.*—First and second antennæ.

gn. 1, *gn.* 2.—First and second gnathopods. These and the preceding details are from the male.

Per. s. 1 ♀—Side plate of first peræon segment in the female.

a.i. ♀—Second antennæ of the female.

mxp. ♀—Maxillipeds of the female.

urp. 1, 2.—Part of pleon of female, showing first and second uropods.

Plate 6B.

Cyathura pusilla, n. sp.

n.s., *n.s.*, *juv.*—Lines indicating natural size, respectively, of adult female figured above and of young one at the side, fourth and fifth peræon segments of young incomplete for want of space. *n.s.* ♂ gives the natural size of the male specimen from which the following details are drawn.

Pl. ♂—Pleon.

mxp. ♂—Maxillipeds.

gn. 1 ♂, *gn.* 2 ♂—First and second gnathopods.

prp. 5 ♂—Fifth peræopod.

THE CICINDELIDÆ OF CEYLON.

By Dr. WALTHER HORN, M.D.

(*Berlin*).

With one Plate.

AMONG the collection of Cicindelidæ or Tiger-beetles recently sent to me from the Colombo Museum for revision I was quite astonished to find a good many species not yet known from the Island of Ceylon, and also one new species and a new sub-species. I had already prepared descriptions of another new species and two new sub-species in my own collection, and now think it best to give a complete list and synopsis of all Ceylon species belonging to this family. Notwithstanding the fact that the Cicindelid fauna of Ceylon must pass as being relatively very well known, almost as thoroughly, for instance, as the corresponding faunas of Java and Sumatra, yet it is probable that more species still remain to be recorded from Ceylon.

In future a particular interest should be taken in the small group represented by the species *Cicindela willeyi*, *waterhousei*, *ganglbaueri*, and *dormeri*, the males of which especially have been as yet but little studied.

A.—CICINDELIDÆ ALOCOSTERNALIÆ, W. Horn.

Entom. Nachr., 1900, p. 214.

COLLYRIDÆ, Chaud.

Bull. Mosc., 1860, pp. 270 and 283.

I.—*Collyris*, Fabr.

Syst. El. I., 1801, p. 226.

Sub-gen. a. *Archicollyris*, W. Horn.
Rev. Cic. Deutsche Ent. Zeitschr., 1901, p. 43.

1. *A. dohrni*, Chaud.
   Bull. Mosc., 1860, p. 286; Monogr. Ann. Soc. Fr. 64, p. 490.
   Locality: Eastern Province.

Sub-gen. b. *Neocollyris*, W. Horn, *l. c.*, p. 45.

2. *N. crassicornis*, Dejean [Spec. I., 1825, p. 166.]
Chaud. Monogr., p. 494, pl. VII., f. 2.
longicollis, Dej. Cat., p. 1.
diardi, McL. Ann. Jav. I., 1825, p. 10.
macleayi, Brl. Rev. Silb. II., 1834, p. 101.
pleuritica, Schm. Goeb. Faun. Birm., 1846, p. 13.
clavicornis, Mannh., *i. l.*, Motsch. Etud. Ent., 1856, p. 22.
Locality: Ceylon.*

3. *N. saundersi*, Chaud. Monogr., p. 496.
mores, W. Horn, Deutsch. Ent. Zeitschr., 1899, p. 392.
Locality: Bandarawela; June.
[Sub-sp. *lætior* (mihi), nov. var., Morawak Korale.]

4. *N. punctatella*, Chaud. Monogr., p. 525.
nietneri, W. Horn, Deutsch. Ent. Zeitschr., 1895, p. 357.
Balangoda; March.

5. *N. plicaticollis*, Chaud. Monogr., p. 534.
Ceylon.

6. *N. ceylonica*, Chaud., *l. c.*, p. 529.
Bogawantalawa; April.

II.—*Tricondyla*, Latr. Dej.

Hist. Nat. Icon. Col. Eur. I., 1822, p. 65.
Sub-gen. a. *Derocrania*, Chaud. Bull. Mosc., 1860, pp. 284 and 297.

7. *D. nietneri*, Motsch. Et. Ent. VIII., 1859, p. 25; 1862, p. 23.
levigata, Chaud. Bull. Mosc., 1860, p. 299.
raptidioides, Schm. Berl. Ent. Zeitschr., 1861, p. 75.
obscuripes, Bat. Ann. Nat. Hist., 1886, p. 70.
Balangoda, Bogawantalawa, Nuwara Eliya, Nalanda; April, May.

8. *D. fusiformis*, n. sp.
Ceylon.

9. *D. gibbiceps*, Chaud. Bull. Mosc., 1860, p. 298.
Nalanda; April–June.

10. *D. flavicornis*, W. Horn, Deutsch. Ent. Zeitschr., 1892, p. 92.
Ceylon.

11. *D. nematodes*, Schm. Journ. Ent., 1863, p. 61, pl. 4, f. 1.
Bogawantalawa.

* In some cases the record of the exact locality in the Island has not been kept.

12. *D. concinna*, Chaud. Bull. Mosc., 1860, p. 298.
Kandy, Nalanda, Puttalam; April–June, October.

13. *D. schaumi*, W. Horn, Deutsch. Ent. Zeitschr., 1892, p. 67.
Kekirawa.

14. *D. scitiscabra*, Walk. Ann. Nat. Hist., 1859, p. 51.
dohrni, Chaud. Bull. Mosc., 1860, IV., p. 297.
Sigiriya, Nalanda; April.

15. *D. halyi*, W. Horn, Deutsch. Ent. Zeitschr., 1900, p. 193; 1899, p. 132.
Anuradhapura, Pankulam, Kanthalai, Trincomalee, Puttalam; May, June.

Sub-gen. b. *Tricondyla** (sens. strict.).

16. *T. coriacea*, Chevr. Rev. Zool., 1841, p. 221.
Kekirawa, Kanthalai, Palatupana, Trincomalee; May.

17. *T. nigripalpis*, W. Horn, Deutsch. Ent. Zeitschr., 1894, p. 224.
Kongawella; May.

18. *T. granulifera*, Motsch. Et. Ent., 1857, p. 110, f. 3.
femorata, Walk. Ann. Nat. Hist., 1858, p. 202.
[Sub-sp. *rugosa*, Chaud. Ann. Fr., 1863, p. 447.]
Haragam, Nalanda; April.

B.—CICINDELIDÆ PLATYSTERNALIÆ, W. Horn.
Entom. Nachr., 1900, p. 214.

CICINDELIDÆ (sens. strict.), Lac.
Mém. Liège, 1842, I., p. 89.

Sub-fam. i. Euryodini, W. Horn, Deutsch. Ent. Zeitschr., 1899, p. 37.

III.—*Euryoda*, Lac., *l. c.*, p. 107.

19. *E. paradoxa*, W. Horn, Deutsch. Ent. Zeitschr., 1892, p. 75; 1893, p. 330.
Puttalam, Matale, Negombo, Colombo, Weligama; April–June.

Sub-fam. ii. Cicindelini, W. Horn, *l. c.*, 1899, p. 37.

IV.—*Cicindela*, L. Syst. Nat., II., 1735, p. 657.

20. *C. corticata*, Putr. Soc. Ent. Belg. (C.R.), 1875, p. 69.
[Sub-sp. *lœticolor* (mihi), nov. var.]
Ceylon.

* *T. tumidula*, Walk. Ann. Nat. Hist., 1859, p. 50, is described by this author as a Ceylon species, but I doubt the locality. The beetle may have been something like *T. mellyi*, Chaud.

21. *C. biramosa*, Fabr. Sp. Ins., 1781, p. 286.
[gen. *Cylindrostoma*, Motsch. Et. Ent., 1859.]
tridentata, Thunb. Nov. Ins. Sp., 1784, p. 26, f. 40.
aberr. *dilatata*, Flt. Ann. Fr., 1893, p. 488.
Mount Lavinia, Trincomalee, Colombo, Weligama, Delft: May–October.

22. *C. quadrilineata*, Fabr., sub-sp. *renei*, W. Horn, An. Mus. Genova, S. II., vol. XVII., 1897, p. 274; Maindron, An. Soc. Fr., 1899, p. 381 (*renati* nom. prop.).
[Gen. *Hypætha*, Lec. Tr. Am. Phil. Soc., 1856, p. 28.]
Colombo; October.

23. *C. waterhousei*, W. Horn, Deutsch. Ent. Zeitschr., 1900, p. 206.
Ceylon.

24. *C. willeyi*, n. sp.
Central Province.

25. *C. dormeri*, W. Horn, Deutsch. Ent. Zeitschr., 1898, p. 198.
Kandy.

26. *C. ganglbaueri*, W. Horn, *l.c.*, 1892, p. 95.
Ceylon.

27. *C. discrepans*, Walk. Ann. Nat. Hist., 1858, p. 202.
Bat. Ann. Nat. Hist., 1886, p. 69.
Colombo, Nalanda.
[Sub-sp. *lacrymans*, Schaum Journ. Ent., 1863, p. 57.]
South Ceylon, Kandy; July, August.

28. *C. sexpunctata*, Fabr. Syst. Ent., 1775, p. 226.
[Gen. *Calochroma*, Motsch. Et. Ent., XI., 1862, p. 22.]
tripunctata, Buq., *i.l.*, Dej. Cat., III., 1837, p. 2.
sexsignata, Buq., *i.l.*, Chaud. Cat., 1865, p. 38.

29. *C. aurovittata*, Brll. Arch. Mus., I., 1838, p. 127, pl. 8, f. 3.
sexpunctata, var. Schaum, Journ. Ent., 1863, p. 62.
Ceylon; October.

30. *C. hæmorrhoidalis*, Wdm. Zool. Mag., II., 1823, p. 3.
quadrimaculata, Sturm, *i.l.*, Cat., 1826, p. 55, pl. 1, f. 1.
flavopunctata, And. Mag. Zool., 1832, pl. 18.
Anuradhapura; May.

31. *C. ceylonensis*, W. Horn, Deutsch. Ent. Zeitschr., 1892, p. 87; 1899, pl. 3, f. 3.
[Sub-sp. *diversa* (mihi), nov. var.]
Trincomalee.

32. *C. calligramma*, Schaum, Berl. Ent. Zeitschr., 1861, p. 69, pl. 13, f. 1.

33. *C. catena*, Fabr. Syst. Ent., 1775, p. 226.
capensis, Herbst., Fuessly Arch. Ins., 1784, p. 115, pl. 27, f. 14.
aberr. *cancellata*, W. Horn (non Dej.), Ann. Soc. Belg., 1892, p. 537 ; Deutsch. Ent. Zeitschr., '897, p. 59.
Colombo, Matale, Kandy.

34. *C. sumatrensis*, Herbst., Kaef., X., 1800, p. 179, pl. 172, f. 1.
catena var. 3*a*, Thunb. Nov. Inst. Sp., 1784, p. 287, pl. 18, f. 43.
westerhauseri, Girtl. Syst. Ins., p. 61.
arenata, Kolt. Ann. Wien. Mus. I., 1836, p. 330.
boyeri, Blanch. Voy. Pole Sud. Ent., IV., 1853, p. 4, pl. 1, f. 2.
leguillou, Guér. Rev. Zool., 1841, p. 121.
Colombo.

35. *C. cardoni*, Flt. Soc. Ent. Belg. (C.R.), 1890, p. 169.
Ceylon.

36. *C. limosa*, Saund. Tr. Ent. Soc., 1834, p. 64, pl. 7, f. 6.
Puttalam ; October. Iranativu ; September.

37. *C. undulata*, Dej. Spec., I., 1825, p. 94.
Puttalam ; October.

38. *C. distinguenda*, Dej. Spec., I., 1825, p. 92.
dohrni, Motsch. Et. Ent., V., 1857, p. 109.
Puttalam ; October.

39. *C. fastidiosa*, Dej., *l.c.*, p. 95.
litigiosa, Dej., *l.c.*, p. 97.
despecta, Flt. *ex parte* Soc. Ent. Belg. (C.R.), 1886, p. 88.
Puttalam ; October.

40. *C. labiocænea*, W. Horn, Deutsch. Ent. Zeitschr., 1892, p. 79.
Puttalam, Negombo, Kandy, Colombo, Yatiyantota, Peradeniya, Nalanda, Weligama, Hatton ; March–June.

41. *C. nietneri*, W. Horn, *l.c.*, 1894, p. 220.
Ceylon.

42. *C. lacunosa*, Putz. Soc. Ent. Belg. (C.R.), 1875, p. 68.
Puttalam ; October.

Some species seem to me to be doubtful as belonging to the fauna of Ceylon, fresh proofs of their appearance being required. Such species are the following :—

Collyris bonelli, Guér., sub-sp. *ortygia*, Buq. Ann. Soc. Fr., 1835, p. 604.

Collyris andrewesi, W. Horn, Deutsch. Ent. Zeitschr., 1894, p. 170.

Tricondyla tumidula, Walk. (*cf.* supra).

Cicindela aurofasciata, Guér. (spec. ?), *i.l.*, Motsch. Bull. Mosc., 1861, p. 95.

Description of New Species and Varieties.

Tricondyla (*Derocrania*) *fusiformis*, n. sp., pl. f. 1.

Derocraniæ gibbicipi Chd. simillima, differt statura majore, figura angustiore ; fronte inter oculos paullo minus excavata, plicis illis 2 longitudinalibus (in specie Chaudoiri distincte elevatis et ultra impressionem punctiformem juxtaorbitalem prolongatis) multo minus distinctis brevioribusque (ante impressiones illas abbreviatis) ; prothoracis parte postica dilatata minus parallela magisque conica (id est in media prothoracis longitudine angustiore), margine antico libero minus profunde emarginato ; elytris angustioribus, in medio et postice minus inflatis, subtilius paulloque densius sculptis ; tibiis tarsisque minus cyanescentibus (magis brunnescentibus). Pronoto elytrisque subbrunnescentibus (non metallicis). Long. 11 mm. (sine labro) : one male.

This small narrow species is closely allied to *Derocrania nietneri*, Motsch., but is a little longer, the head narrower, and the interorbital region of the frontal area plainer ; the prothorax (anterior and posterior half) is narrower and longer, and less inflated behind the middle. The elytra are more elongate, with the whole surface (except the extreme apex) densely punctured. *D. nietneri* has the prothorax and the elytra metallescent, the tibiæ and tarsi lighter rufescent. In the new species the two longitudinal plicæ of the front are prolonged backwards in the form of indistinct impressions.

Collyris saundersi, Chd., sub-sp. *lætior*, n. var.

Differt a typo statura paullo minore ; colore supra subtusque (capite nigricante) subolivascente ; femoribus coxisque rufobrunnescentibus ; tibiis aut cyaneis aut rufotestaceis ; tarsis totis cyaneis aut primo pedum intermediorum posticorumque articulo brunnescente ; prothoracis collo antico minus abrupte constricto paulloque crassiore. Long. 13–16 mm. : one male, two females.

The few differences noted impart a distinct character to the sub-species. I suppose that the specimen caught by G. Lewis near Colombo and mentioned by H. W. Bates (Ann. Nat. Hist., 1886, p. 71) belongs to this new sub-species.

Cicindela corticata, Putz., sub-sp. *læticolor*, n. var.

Differt a typo statura majore robustiore; capite prothoraceque crassioribus; fronte inter oculos vittis 2 cyanescentibus ornata; prothoracis episternis paullo densius punctato-pilosis; elytris amplioribus, superficie æquali (impressionibus illis levissimis aut longitudinalibus aut omnino irregularibus deficientibus), serie punctorum viridimicantium longitudinali evidentiore, punctura et antice et postice rariore nusquam confluente; macula flavescente antica majore (magnitudine illius posticæ) marginique æqualiter approximata atque anteapicali; 4 primis antennarum articulis paullulum brunnescentibus, femoribus pallidis vix hinc inde metallescentibus, penultimo palporum maxillarium articulo toto flavo. Corpore supra lætius brunneo-cuprascente, elytris opacis. Long. 9–10¼ mm.: one male, two females.

The three specimens originate from three different collections, namely, coll. Tshoffen, coll. Nonfried, coll. Schlüter. The male differs from the female by the smaller size, narrower shape, shorter labrum without any tooth, and the tip of the elytra a little more tapering. The penis shows a long hook. The two violaceous spots between the eyes in the male specimen examined by me may prove to be accidental.

I am not quite sure about the pubescence of the abdomen in the new sub-species; the lateral parts may be a little more, the disk perhaps rather less covered with hairs than the type.

Cicindela willeyi, n. sp., pl. f. 4.

C. waterhousei similis, differt fronte inter oculos magis excavata, vertice angustiore; pronoto angustiore longioreque, ab angulis anticis usque ad angulos posticos gradatim (lateribus rectis) dilatato, margine antico discoque paullo distinctius transversim plicatis; elytris in medio magis dilatatis; parte apicali multo longius arcuato-angustata, extremo apice brevius rotundato, spina suturali valde longiore; orbitis, scutello, extremo elytrorum apice, malis, prothoracis episternis læte cyaneis; palpis maxillaribus flavis, dimidia parte distali articuli ultimi metallica; macula flava in angulo humerali posita valde minuta aut deficiente. Long. 8–9½ mm. (sine labro): two females, Central Province.

The other allied species are *C. dormeri* m. and *C. ganglbaueri* m. The former is already sufficiently distinguished by the parallel shape of the pronotum and the elytra (*cf.* pl. f. 10);

the latter is larger than the new species, all coppery reflexions are replaced by greenish colorations, the labrum is black-metallic, the prothorax a little broader, the elytra in the middle much less dilated, the apex broadly and simply rounded with short sutural spine, the whole last joint of the maxillary palps metallic, &c.

Cicindela ceylonensis m., sub-sp. *diversa* (nov. var.), pl. f. 19.

Differt a typo statura paullo robustiore elytrorumque signatura; linea flava humerali valde breviore, stria obliqua mediana evidenter longiore, macula apicali paullo breviore marginemque versus latiore. Long. 16½–19 mm. (sine labro): one male, one female, Trincomalee (A. Humbert).

It differs from the type by the form of the body a little larger and broader, the tooth of the labrum ♂ a little less produced, the sides of the pronotum a little more rounded, the second joint of the maxillary palps ♂ testaceous-metallic, with the third one black-metallic and by the pattern of the elytra: the humeral stripe is evidently shorter, the oblique line in the middle is longer, the apical spot mostly shorter and broader, approaching nearer to the margin and posteriorly dilated. The pubescence of the body may be perhaps a little scarcer ventrally.

Synopsis of the Genera.

I.—Episterna of the metathorax long and narrow, deeply sulcated.
  A.—Labrum with 7 teeth, lateral part of the mentum without spine, elytra separated, with wings, 7th segment of the abdomen ♀ with 2 (towards the base, sometimes connected) spines ... *Collyris*
  B.—Labrum with six teeth, lateral part of the mentum with a spine, elytra connected, without wings, 7th segment of the abdomen ♀ without spines ... *Tricondyla*

II.—Episterna of the metathorax large, wide, and plain, never longitudinally sulcated.
  A.—Body without pubescence ... *Euryoda*, pl f.
  B.—Body with pubescence ... *Cicindela*

Synopsis of the Collyris, sp.

I.—Vertex (before the deep strangulation) short, anteriorly (on the summit) in form of a transverse semilunar line sharply broken (towards the mid-front) *Archicollyris* dohrni, Chd.

II.—Vertex long and anteriorly rotundate; bent ... ... *Neocollyris*

A.—Feelers sometimes short, towards the apex strongly incrassated; intermediate space between the two longitudinal sulci of the front more or less convex, the two sulci convergent behind; middle part of the prothorax in the front distinctly constricted (collum sharply formed), lateral part of the metasternum widely and densely punctated-pilose.

(*a*) Distance from the fore-margin of the labrum to the fore-margin of the pronotum longer than the prothorax ... crassicornis, Dej.*

(*b*) —— shorter than the prothorax ... saundersi, Chd.

B.—Feelers slightly incrassated; intermediate space of the front plain, the two sulci not convergent behind; middle part of the prothorax without distinct collum in the front, lateral part of the metasternum with a small and scarcely punctured space ... punctatella, Chd.

C.†—Feelers long and thin (intermediate space of the front parallel and plain: teste descriptionibus), middle part of the prothorax without distinct collum.

(*a*) Length 19½ mm., pronotum deeply and densely (transversely) plicated, elytra almost always equally densely and coarsely sculptured (the whole metasternum densely pilose ?) ... plicaticollis, Chd.

(*b*) Length 12½ mm., pronotum moderately plicated, elytra towards the base and apex evidently finer and scarcer sculptured (lateral part of the metasternum not pilose ?) ... ceylonica, Chd.

SYNOPSIS OF THE TRICONDYLA, sp.

I —Vertex without circular constriction ... *Tricondyla*, sp.

A.—Two last joints of all palpi reddish brownish ... ...granulifera, Motsch‡

* Surface of the body violaceous or black.

† Chaudoir's descriptions are not very perfect.

‡ Sub-sp. *rugosa*, Chd., only differs from the type by the elytra more inflate and coarser sculptured.

B.—Two last joints of all palpi black.

(*a*) Puncture in the middle of the elytra separate ... ... coriacea, Chevr.

(*b*) Puncture in the middle of the elytra more or less confluent ... nigripalpis, m.

II.—Vertex with circular constriction ... *Derocrania*, sp.

A.—Front between the posterior half of the eyes not excavated, prothorax anteriorly with a distinct "collum" or neck.

(*a*) Elytra posteriorly almost smooth ... nietneri, Motsch.*

(*b*) Elytra posteriorly deeply and densely punctured.

1. The two longitudinal plicæ of the forefront not reaching to the level of the punctiform impression near the border of each orbit ... ... fusiformis, n. sp. pl. f. 1

2. The two plicæ in the middle of the front surpassing the lateral impressions.

(*α*) "Collum" long and thin; tibiæ, feelers, and palpi black ... gibbiceps, Chd.

(*β*) Collum stout and short; tibiæ, 3rd–6th joints of the feelers, and two last joints of the palpi testaceous flavicornis, m., pl. f. 2

B.—Front between the posterior half of the eyes excavated.

(*a*) Prothorax without distinct collum; longitudinal middle stripe of the front more or less continuously convex, without† trace of a large arcuate excavation just before the summit of the vertex.

(1) Tibiæ and 3rd–6th joint of the feelers testaceous ... nematodes, Schm.

(2) Tibiæ and feelers black (sometimes with a metallic sheen).

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* *Obscuripes*, Bat., is identical with the type. I cannot find any positive differences.

† I do not speak of the two sometimes transversely confluent, punctiform impressions in the middle of the front between the hind borders of the eyes.

(α) Elytra coarsely punctured ...	concinna, Chd.
(β) Elytra finely and densely (about as coarsely as in *Tr. scitiscabra*, Walk.) sculptured ...	schaumi, m.
(b) Prothorax with distinct collum; middle stripe of the front more or less applanate, separated from the vertex by an indistinct large arcuate excavation running between the posterior half of the orbits from one side to the other (behind the end of the two longitudinal sulci).	
(1) Middle of the elytra separately punctured	scitiscabra, Walk.
(2) Middle of the elytra coarsely transversely-confluently sculptured	halyi, m., pl. f. 3

SYNOPSIS OF THE CICINDELA, sp.

(1)	Lateral margin of the pronotum without bristles	2
	Lateral margin of the pronotum with bristles	10
(2)	Whole surface of the episterna of the metathorax with pubescence ...	3
	Whole surface of the episterna of the metathorax almost naked ...	9
(3)	Labrum covers the whole (shut !) mandibles, except the tip of the end tooth	corticata, Putz., pl. f. 6
	Labrum leaves exposed the greater half of the mandibles, the end tooth, and at least the preceding one ...	4
(4)	Abdomen at least with some bristles ...	5
	Abdomen glabrous	biramosa, F,* pl. f. 7
(5)	Episterna of the prothorax densely pubescent, elytra ♀ without mirror ...	quadrilineata, sub-sp. renei. m., pl. f. 8
	Episterna of the prothorax almost naked	6

* Aberr. dilatata Flt. has the yellow pattern of the elytra a little broader than the type.

(6)	Labrum yellow, pronotum ♀ narrowed towards the front	7
	Labrum brown or darker, pronotum ♀ sometimes parallel-sided ...	8
(7)	♀ apex of each elytron simply tapering-rounded	waterhousei, m., pl. f. 9*
	♀ apex of each elytron sinuated prolonged	willeyi, n. sp., pl. f. 4
	(♂ not known yet)	
(8)	Labrum dark brownish, ♂ tip of each elytron obliquely rounded, pronotum ♀ ♂ parallel	dormeri, m., pl. f. 10*
	Labrum black metallic, ♂ tip of each elytron broadly rounded-truncated, pronotum ♀ dilated behind ...	ganglbaueri, m., pl. f. 11†
(9)	Lateral borders of the abdomen naked...	discrepans, Walk., pl. f. 12‡
	Lateral borders of the abdomen pubescent	sexpunctata, F., pl. f. 14
(10)	Cheek with bristles ...	13
	Cheek without bristles ...	11
(11)	Greatest part of the episterna of the pro- and metathorax naked ...	12
	Greatest part of the episterna of the pro- and metathorax or the whole surface pubescent	17
(12)	Borders of the elytra shining, tip of the abdomen black metallic ...	aurovittata, Br., pl. f. 15

* I now know one ♂ of it which differs from the ♀ by the narrower prothorax (greatest width a little behind the middle); the elytra are less dilated near the middle without mirror and shining shoulder (tip of the single elytron not rounded); the right mandible shows the end tooth longer but thinner than the preceding one, the left one has it shorter but thinner (one of the males of C. dormeri repeats the same formation).

† One ♂ is known to me differing from the ♀ by the smaller size, parallel prothorax (pronotum finer plicated), and the missing mirror of the elytra which are also more parallel.

‡ The typical form differs from sub-sp. *lacrymans*, Schm., pl. f. 13, by the much stouter and bulkier shape of the head, prothorax, and elytra, the less produced teeth of the shorter labrum, the pronotum a little deeper and rougher transversely sculptured, the stouter legs, the black metallic second joint of the maxillary palps, and the larger and broader yellow spots of the elytra (the apical one much nearer the margin than the anterior ones).

	Borders of the elytra dull, tip of the abdomen reddish testaceous ...	hæmorrhoidalis, Wdm., pl. f. 16*
(13)	Disk of the pronotum with bristles	14
	Disk of the pronotum without bristles	16
(14)	Cheek and first joint of the feelers with dense pubescence, front with bristles behind the articulation of the feelers and near the hind margin of the eyes	catena, F.,† pl. f. 20
	Cheek scarcely pubescent; first joint of the feelers (never densely hairy !) and front almost in all specimens naked	15
(15)	Episterna of the prothorax laterally naked, those of the metathorax only near the extreme borders with bristles	ceylonensis, m., pl. f. 18
	The whole or almost the whole surface of the episterna of the prothorax (moderately) covered with bristles...	calligramma, Schm.,‡ pl. f. 17
(16)	Mandibles of ordinary size : moderately stout and sharp	cardoni, Flt., pl. f. 21
	Mandibles very elongated and very sharp (elytra shorter and—especially ♀—dilated in the middle) ...	sumatrensis, H., pl. f. 22
(17)	Intercoxal process of the metasternum and interior part of the hind hips naked	18
	Intercoxal process of the metasternum and interior part of the hind hips pubescent	limosa, Saund., pl. f. 23

* I discovered two larvæ of it in a hill of white ants at Anuradhapura (conf., W. Horn, Deutsche Ent. Zeitschr., 1899, p. 234).

† Aber. cancellata, m. (non Dej.!), differs from the type by the narrower pattern of the elytra : the middle band more or less separated from the two lunules.

‡ The tip of the shoulder lunule is sometimes separated from the middle spot, sometimes largely connected with it ; surface of the body green or brownish.

(18) Femora with ordinary (straight, moderately long and stout) bristles ... 20

Femora with two kinds of bristles: straight ones and curved-hooked ones.* 19

(19) (*a*) Labrum ♀ with 3 well-developed teeth, ♂ lateral tooth small, eyes widely prominent, prothorax dilated before the middle, elytra pretty wide (not very narrowed at the shoulders), ♂ second last joint of the maxillary palps testaceous-metallic, surface of the body dirty green-brassy, 1st to 4th joint of the feelers metallic, all episterna mostly greenish, nearly the whole surface of the episterna of the prothorax pubescent, hind hips almost always black-metallic, legs metallic, hind femora interiorly till about the extreme end densely bordered by hooked bristles, ♀ without distinct trace of a mirror. Length of the body 10–11 mm. ... distinguenda, Dej., pl. f. 26

(*b*) Labrum ♀ like (*a*), ♂ lateral tooth almost disappeared, eyes a little less prominent, prothorax narrower and more or less parallel, elytra—especially anteriorly—narrowed, maxillary palps like (*a*), surface of the body grayish-greenish-brassy, 1st to 4th joint of the feelers metallic, episterna coppery or greenish, those of the prothorax naked towards the pronotum, hind hips testaceous, legs metallic, hind femora pubescent like (*a*), ♀ with a slight (not very shining) mirror. Length $9\frac{1}{4}$–$10\frac{1}{2}$ mm. ... ... undulata, Dej., pl. f. 24

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* Hooked hairs (bristles) are not always a constant feature for the same species! For instance, the small brownish specimens of *Cicindela octoguttata*. Oliv., show them, the larger dark ones of it have only scarce straight hairs.

(*c*) Labrum ♀ like (*a*), ♂ only with a middle tooth; eyes, prothorax—pronotum a little rougher—and elytra like (*a*), second last joint of the maxillary palps yellow, surface of the body brownish-brassy, first joint of the feelers and tip of the 3rd and 4th one mostly testaceous, episterna coppery, hind hips reddish-testaceous, femora and tibiæ mostly* testaceous, hind femora interiorly scarcely and sometimes almost only towards the base bordered by hooked bristles, ♀ without mirror. Length $8\frac{3}{4}$–10 mm.		fastidiosa, Dej., pl. f. 25
(20) Disk of the abdominal segments shortly and scarcely pubescent ...	21	
Disk of the abdominal segments naked		lacunosa, Putz., pl. f. 28
(21) Eyes very prominent, head behind the eyes slightly arcuated-constricted ...		labioænea, m.,† pl. f. 27
Eyes moderately prominent, head behind the eyes at first dilated then sharply constricted ...		nietneri, m. (the same pattern as pl. f. 27)

Berlin, October 15, 1903.

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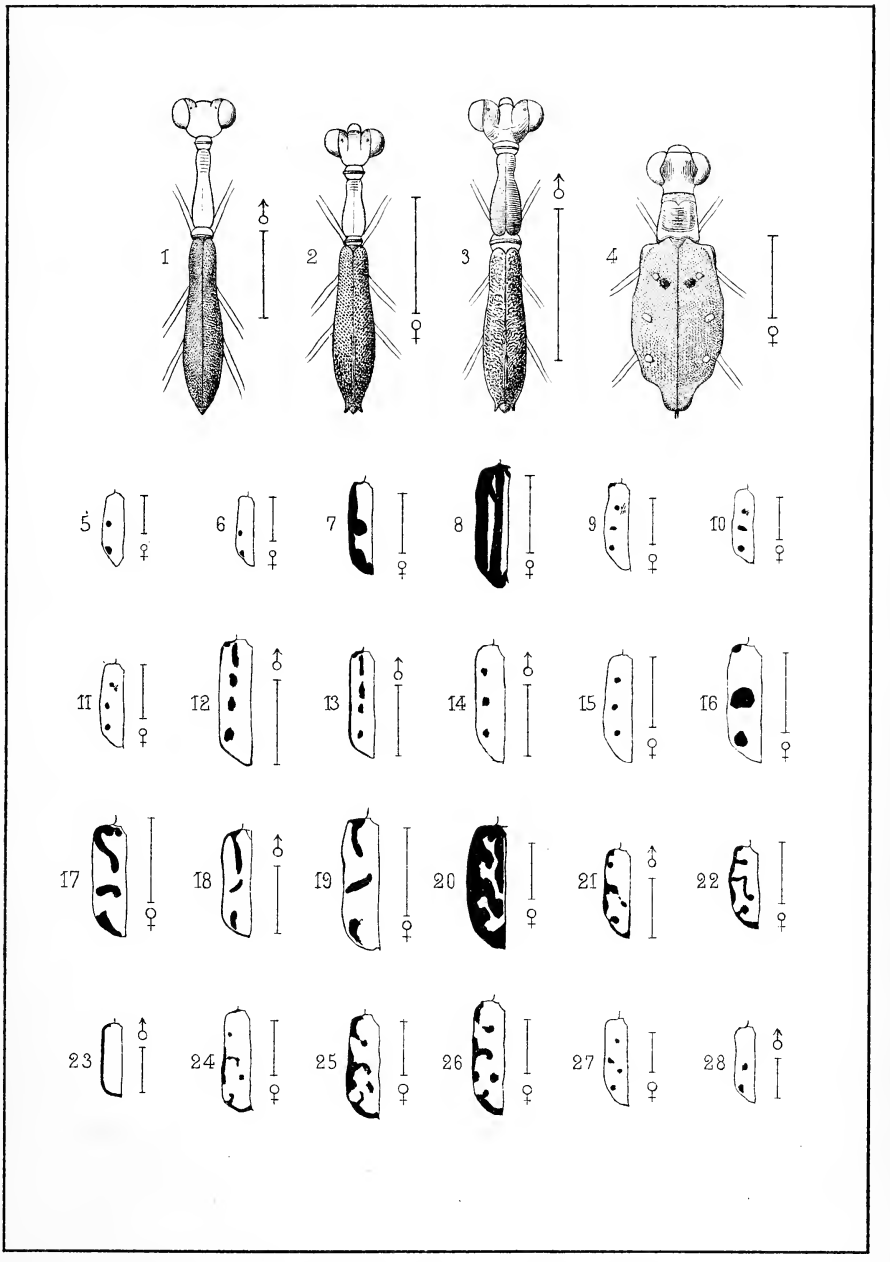
* Most of the Ceylon specimens have yellow testaceous femora and tibiæ, in contrast with most of the Continental specimens, which have them metallic.

† The exceedingly poor material (two specimens) that is known of the typical *C. vividilabris*, Chaud., and its unknown locality (probably the North of India), does not allow me to decide whether *C. labioænea*, m., is but a sub-species of *C. vividilabris*. Chaud.



CI~~N~~CINDELIDAE. HORN.

EXPLANATION OF THE PLATE

Illustrating Dr. Horn's Paper on the Cicindelidæ of Ceylon.

Fig. 1.—Derocrania fusiformis.
Fig. 2.—Derocrania flavicornis.
Fig. 3.—Derocrania halyi.
Fig. 4.—Cicindela willeyi.

In the following figures only the left elytron is shown. The yellow markings are rendered in black, the dark ground colour being left white.

Fig. 5.—Euryoda paradoxa.
Fig. 6.—Cicindela corticata.
Fig. 7.—C. biramosa.
Fig. 8.—C. quadrilineata renei.
Fig. 9.—C. waterhousei.
Fig. 10.—C. dormeri.
Fig. 11.—C. ganglbaueri.
Fig. 12.—C. discrepans.
Fig. 13.—C. discrepans lacrymans.
Fig. 14.—C. sexpunctata.
Fig. 15.—C. aurovittata.
Fig. 16.—C. hæmorrhoidalis.
Fig. 17.—C. calligramma.
Fig. 18.—C. ceylonensis.
Fig. 19.—C. ceylonensis diversa.
Fig. 20.—C. catena.
Fig. 21.—C. cardoni.
Fig. 22.—C. sumatrensis.
Fig. 23.—C. limosa.
Fig. 24.—C. undulata.
Fig. 25.—C. fastidiosa.
Fig. 26.—C. distinguenda.
Fig. 27.—C. labioænia.
Fig. 28.—C. lacunosa.

DIAGNOSIS OF A NEW SPECIES OF ELATERIDÆ IN THE COLOMBO MUSEUM.

By O. SCHWARZ.

(*Berlin.*)

Adelocera subaurata, n. sp.

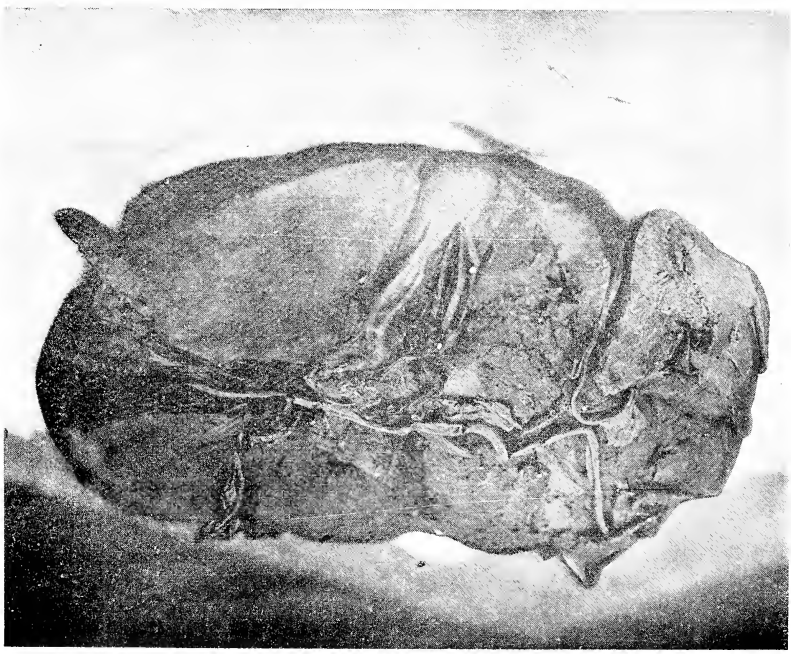
NIGRO-FUSCA, squamulis subauratis, dense vestita; fronte impressa, dense punctata; prothorace latitudine paullo longiore, lateribus paullo arcuatis, antrorsum paullo angustato, dense sat fortiter punctato, haud canaliculato, angulis posticis divaricatis, rectis haud carinatis; elytris prothoracis latitudine, a medio rotundatim attenuatis, dorso haud impressis, seriatim punctatis, interstitiis planis, dense punctulatis; corpore subtus nigro, nitidiore, dense punctato, brevissime breviterque griseo-pilosulo, pedibus fuscis. Long. 18 mm., lat. $3\frac{1}{2}$ mm.

Brownish black, thickly beset with short golden yellow scales. The frontal area is concave, densely punctate; the prothorax is somewhat longer than broad, with slightly rounded and anteriorly narrowed sides, strongly pitted. The wing-covers are as broad as the prothorax, rounded and narrowing from the middle backwards, with longitudinal rows of pits and flat finely punctate interspaces.

The lower surface is beset with very fine gray hairs; the legs dark brown.

This species is related to *A. tumulosa*, Cand.

PORTION OF PANCREAS SHOWING ASCARIS IN THE DUCT OF WIRSUNG.



LIVER SHOWING ASCARIS IN BILE DUCTS AND GALL BLADDER.

To face p. 47]

ASCARIS LUMBRICOIDES IN THE LIVER AND PANCREAS OF MAN.

By Albert J. Chalmers, M.D., F.R.C.S.

Registrar of the Ceylon Medical College.

With two figures.

ASCARIS LUMBRICOIDES is one of the commonest parasites of man, and in Ceylon it is seldom that the human fæces are examined, at all events in natives, without the ova being seen, and certainly during the last three years I have never performed an autopsy in the General Hospital, Colombo, without finding the worm in the intestine.

It is also exceedingly usual to find that the worm has wandered from the alimentary canal into some part of the body, *e.g.*, the mouth, larynx, lungs, nose; and some sixty-eight cases are recorded of invasion of the bile duct, but it is by no means so common to find that a person dies from the effects of *Ascaris lumbricoides*, and to find post-mortem that it has caused serious lesions of an organ like the liver. It is also not common to find that it has invaded the pancreas, only about nine cases being recorded.

The following is an account of a case in which death was directly due to *Ascaris lumbricoides*.

An autopsy was required upon a Tamil woman, aged 29, who had died with obscure symptoms. On entering the post-mortem room, I was immediately struck with a peculiarly unpleasant odour arising from the body, which was in no way decomposed having died in the early hours of the morning, which was cold, the post-mortem being held ten and a half hours after death It was noticed that ascarides had escaped by the mouth and the anus, but there was nothing unusual in these observations.

On opening the body the odour which was previously noted increased when the abdomen was cut into.

The points of interest are with regard to the abdominal organs, which alone will be described.

The peritoneum was injected, and its cavity contained ten ounces of clear straw-coloured fluid.

The stomach was normal in every respect.

On opening the small intestines the previously mentioned odour was felt almost overpoweringly.

In the bowels there were masses of round worms interlaced with one another, all along the small intestine from the duodenum to the end of the ileum. There were not many in the large intestine.

It is no exaggeration to state that the worms numbered several hundreds, only the extraordinary overpowering odour prevented them being carefully counted.

The small intestine was slightly inflamed, but not markedly so.

The bile duct was found to be much enlarged; on making an opening it was seen to be filled with round worms.

Eleven fairly well-developed specimens of ascaris lay side by side in the duct.

There were no worms in the cystic duct, but in the gall bladder, which did not contain any bile, there was a single ascaris, which was doubled upon itself.

Upon slitting up the bile ducts it was found that the worms penetrated into the liver along dilated bile passages in many directions, till they lay just beneath the capsule. Tracing these bile passages upwards towards the diaphragm, it was found that in three instances the ends of the worms lying near the capsule were surrounded by small abscess cavities.

The pancreas was slightly inflamed, and an ascaris was found lying along the whole length of the duct of Wirsung from near its junction with the common bile duct to near its splenic extremity.

Remarks.

There is no doubt in my mind that the death of this woman was due directly to poisoning by the enormous numbers of ascarides which lived in her small intestine. No one who felt the effects of that peculiar odour upon himself could doubt the toxic effect of these worms upon the living body.

There is, of course, no doubt that the ascarides penetrated the liver during life, and that they caused the three little abscesses and the dilated bile passages.

There is more doubt as to whether the ascaris in the duct of Wirsung was ante- or post-mortem, but taking into consideration the slightly inflamed condition of the pancreas, I am inclined to believe that it was ante-mortem.

Abscess of the liver, single or multiple, caused by ascarides is apparently very rare, but it is by no means unknown, cases having been recorded by Tonnelé, Pellizari, Forget, Lebert, Lobstein,

Kirkland, Kartulis, and Hoehler. I believe, however, that this is the first case of its kind reported in Asia and certainly in Ceylon. Several other observers, including Davaine, Lænnac, have recorded cases of ascaris in the liver without abscess formation.

With regard to the ascaris in the pancreas this is also apparently not very common, even assuming post-mortem entry, but there are only a very few cases recorded in which there was evidence in favour of an ante-mortem entry, and only one, by Durante, in which such entry was absolutely proved by the fact that the worm was found in a cyst of the pancreas caused by occlusion of the duct of Wirsung.

References.

Davaine: Traité des Entozoaires, Paris, 1877.

Kartulis: Ueber einem Fall von Auswanderung einer grossen Zahl von Ascariden in die Gallengänge und die Leber. Centralblatt fur Bact. Parasitenkunde, Bd. I.

Hoehler: Ein Fall von Leber-Abscessen verursacht durch einen Spulwurm.
Dissertation Greifswald, 1895.

January 21, 1904.

NOTES.

1. *Crows and Flying Foxes at Barberyn.*—In February of this year I had the privilege, by kind permission of Captain A. Channer, R.N., of spending a few days at the small island opposite to Beruwala upon which the Barberyn Lighthouse stands, some 35 miles south of Colombo. The island is covered by a cocoanut plantation and is uninhabited, except by the lighthouse staff and one or two natives working on the plantation. I had formerly paid a flying visit to the island, arriving there on both occasions in the heat of the day without noticing anything out of the common.

On making a more extended stay at the place on the second occasion I heard on the first evening a great commotion of crows among the tree tops. On the following morning towards sunrise, instead of the intermittent chorus of the crows, I was somewhat surprised by the chattering and squabbling of numerous flying foxes* overhead. Even then I paid no particular heed to the noisy creatures, until the next evening at sundown, when I witnessed what was to me a most interesting sight, namely, the passage in opposite directions across the strait which divides the island from the mainland of immense flocks of crows and flying foxes, the former bound for the island to rest for the night, the latter speeding their way to the mainland intent upon their nocturnal forage.

The flying foxes flew on the average distinctly higher than the crows, starting singly and increasing to large flocks of twenty-five and upwards, finally becoming a continuous stream. The crows obviously outnumbered the bats, although weight for weight they probably represented an equivalent bulk of living matter. The crows also began to arrive in small numbers before the vanguard of the bats had started, increasing in their turn to large battalions until a period of maximum migration was reached, when troops of bats were to be seen passing over still larger columns of crows. The whole of the cross-migration occupied about half an hour, after which solitude reigned supreme.

It still remained to witness the matutinal flights. Accordingly on the next day shortly before sunrise I heard the cawing of crows mingled with the chattering of a few flying foxes. This

* *Pteropus medius*, the Indian fruit bat or flying fox, here called má-wawulá.

meant that the crows were waking up and that the bats had already commenced to arrive. I hastened down to the jetty and watched the reverse passage, the bats returning from the mainland to rest for the day and the crows crossing over on their daily quest for garbage.

During the day the bats may be seen suspended in rows from the midribs of the palm leaves, resembling hanging fruits when observed from a distance. If a gentle land breeze is blowing out to sea it carries along with it a penetrating odour of bats.

The homing of the Indian or gray crow at sunset is well known to residents of Colombo and other parts of the Maritime districts of Ceylon.* In Amboina, Semon observed somewhat similar habits in the case of fruit-eating pigeons of the genus *Carpophaga*. These pigeons used to swarm about the forests during the daytime following their individual pursuits, assembling at sunset on certain trees singled out for their nightly repose. Professor Semon had never observed this habit in any other bird except in the case of herons. (R. Semon, "In the Australian Bush," 1899, p. 505.)

Similarly flying-fox camps are well known in tropical countries. One at Peradeniya is mentioned by Sir William Gregory in his Autobiography (1894, p. 348), and may still be inspected there in the Botanic Gardens. Another was described by Semon in Queensland, inland from Cooktown, situated in a dense scrub of forest trees, where the fruit bats hung in thousands taking their day's rest. (Semon, *op. cit.*, p. 261.)

I do not know of any published description of reciprocal relations having become established between communities of birds and of fruit bats such as occurs at Barberyn,† the same trees affording hospitality in regular alternation to day-flying birds and night-flying mammals. I think it is a noteworthy example of synchronised homing instincts of gregarious creatures.

A. WILLEY.

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2. *Leaf-mimicry*.—It is one of the most familiar facts of biology that many animals, chiefly insects, bear a decided resemblance to the plants upon or amongst which they live, thus acquiring an apparent advantage for themselves either in the way of rendering themselves invisible to their foes or attractive to their prey. There are flower-mimics, twig-mimics, and leaf-mimics. The floral simulators are perhaps the least common, and

* *Cf.* Spolia Zeylanica, vol. I., part II., p. 27.

† I am told that the same phenomenon recurs on islands in the Bentota river.

include predatory insects such as certain Mantidæ and dragon flies. The twig-mimics include the stick insects or Phasmidæ, some water bugs, and many caterpillars, members of at least three different orders of insects, Orthoptera, Hemiptera, and Lepidoptera. The leaf-mimics include such remarkable creatures as the leaf insects of the genus *Phyllium*, living examples of which have been exhibited for some months at this Museum, showing a striking resemblance to the guava leaves upon which they feed, sometimes actually nibbling at the flattened expansion of the bodies of their own kindred.

A singular fact in connection with the stick and leaf insects which belong to allied families of Orthoptera is that their eggs closely resemble plant seeds.

Another still more celebrated example of leaf-mimicry is afforded by the Nymphalid butterflies of the genus *Kallima*, a fine series of the Ceylonese species, *K. philarchus* from Haputale, being on exhibition at the Museum.

The object of the present note is to bring forward a further example of leaf-mimicry which is by no means so well known, if indeed it has ever been published. I am not aware that it has been described before. It is a case in which a marine fish resembles, almost to distraction, a faded leaf. This may appear extremely improbable, and of course it should be seen to be believed.

In March, 1903, a gentleman, Mr. R. Gordon-Smith, brought to the Museum for identification several small fishes which he had captured in the Colombo Harbour. They were examples of the so-called sea bats, *Platax vespertilio*, family Carangidæ. These fishes are remarkable for their thin wafer-like body and greatly elongated dorsal and anal fins.

At my request Mr. Gordon-Smith was good enough to write a letter to me detailing the circumstances under which the specimens were obtained. He wrote as follows from the Galle Face Hotel under date March 22, 1903 :—

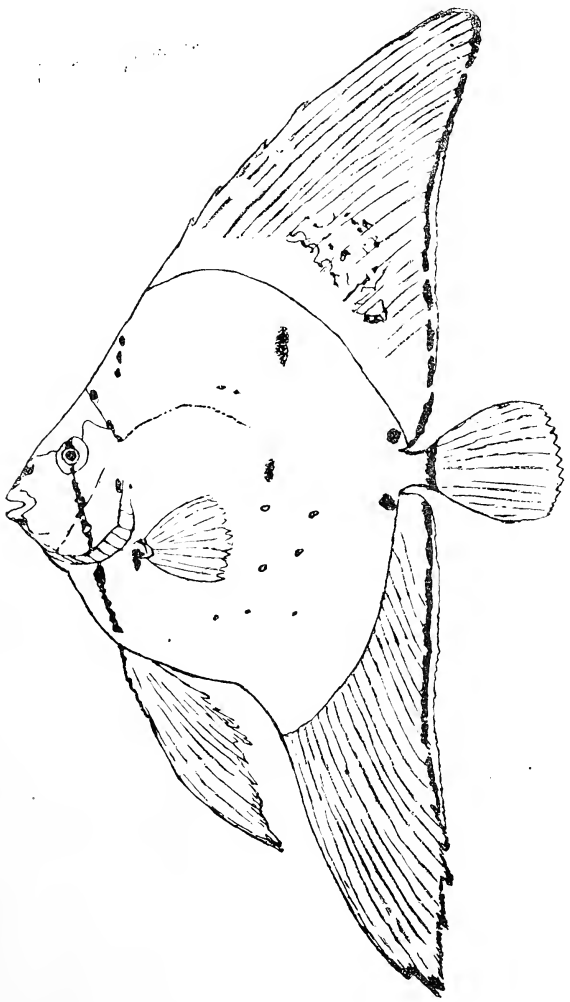
"Respecting the 'sea bats' (*Platax vespertilio*) which I left with you, I regret to say that I am unable to spare them as I send all my strange fish to Mr. Boulenger and the British Museum ; if, however, they have them there I shall see that they are sent back to Colombo, as they appear to be rare here.* .....

"The specimens in question (of which there are three) were observed by me about ten days ago while fishing from the inside of the breakwater within about 100 yards of the end. The three

* One of the specimens was kindly sent back to the Colombo Museum by Mr. G. A. Boulenger, F.R.S., on behalf of Mr. Gordon-Smith in the following May.

fish struck me at first as three animated oak leaves, floating half sideways, but progressing the same way. When one turned they all turned .....

"Seeing their slowness I got a couple of boys to jump over the side and capture one, which they did, and swam with him to the steps at the end of the jetty. I made them return for the second and third fish in turn, which they also successfully captured.



Platax vespertilio.

Sketch of a living specimen.

These fish seemed unable to take care of themselves on the surface of such deep water, and were only able to move with any rapidity when they got on a level keel and tried to bore downwards, but they gave this up after several attempts. In appearance the fish

resemble, as I said before, a waterlogged oak leaf. None of the jetty fishermen had seen such a fish before, and until I was with you to-day I had some slight hopes that I had added one more fish to my credit as new to science."

When the fishes are taken out of water they lose to a certain degree the strangeness of their appearance, and when they are preserved the fins collapse and contract, so that even the best drawing will fail to catch the living aspect of the animal. The individuals observed by Mr. Gordon-Smith appear from his account of their defective movements to have been in an abnormal condition, unable to progress in a definite direction or to flee from the wrath to come in the shape of their captors. So far as can be judged, they presented the symptoms of fishes disabled by the concussion of dynamite. The probability that they had been suffering in some particular rather detracted from their bionomical interest, and rendered any theoretical deduction based upon their fancied resemblance to a faded leaf, impracticable.

Under these circumstances I was very pleased indeed to have the opportunity of seeing for myself the peculiar movements of a *Platax vespertilio* under perfectly normal conditions inside the reef at Beruwala in February of this year. I was walking along the reef in the company of a fisherman carrying a net when he espied a small fish, which he attempted to catch for me. I could not see what it was at first, but noticed that the man failed to bag it after several ineffectual attempts. The fish did not swim far away from the spot, but dodged about baffling its pursuer. I approached and seized the net, whereupon I saw a yellow jak leaf gently and inertly sinking to the bottom. This is surely no unusual sight close inshore, and I was about to turn away, when to my astonishment the leaf righted itself and darted away. Efforts were then redoubled and the fish secured and subsequently I sketched it alive to show as far as possible its natural contour.

When a fish has a leaf-shaped and leaf-coloured body and in addition has the unique habit of toppling over and feigning death when pursued, it seems natural to conclude that it is a genuine example of protective resemblance.

Under water the general contour of the fish is almost identical with that of the leaf-butterfly when resting with closed wings. The contour along the posterior border is strengthened by a dark line of pigment along the margin of the dorsal and anal fins passing across the base of the tail fin. The tail fin itself is unpigmented, perfectly transparent, and consequently invisible under water. The pectoral fins are also transparent, but the elongated ventral fins are opaque, showing the yellow ground colour and a dense outer border

conterminous with the border of the anal fin, thus preserving the continuity of the anterior contour.

It is quite impossible to exaggerate its likeness to a leaf, and it is interesting to learn that the native fishermen also recognize the similarity by calling the fish *koskolaya*,* which means jak-leaf. The surface of the body shows lines of pigment and small spots such as are seen in a decaying leaf. These are subject to variations similar to those which occur on the undersides of the wings of *Kallima* and on the wings and body of *Phyllium*. Only a careful coloured drawing of the living fish by an artist could do justice to its wonderful form. The figures of this species which have been published in various monographs completely fail to reproduce its essential attributes.

Other cases of protective resemblance among fishes are known and have become classical, but I know of no other instance in which the leaf-form has been acquired. The cases of *Phyllium*, *Kallima*, and *Platax* are illustrations of the phenomenon known in Germany as convergent evolution and in England as parallel evolution. It is a factor of wide application in biology, sometimes, as in the preceding instances, easy to recognize, sometimes obscure and questionable, but always remarkable and difficult to explain otherwise than in a purely formal manner.

Colombo, March 16, 1904. A. WILLEY.

* It is also sometimes called *nona*.

SPOLIA ZEYLANICA.

ISSUED BY

THE COLOMBO MUSEUM,

CEYLON.

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COLOMBO:

GEORGE J. A. SKEEN, GOVERNMENT PRINTER, CEYLON.

1904.

MINERALOGICAL NOTES.

By A. K. Coomaraswamy, B.Sc.,

Director, Mineralogical Survey of Ceylon.

I.—The New Mineral.

In 1903 Mr. W. D. Holland (who has long taken an interest in the mineralogy of the Bambarabotuwa district) obtained a quantity of a heavy black mineral occurring in cubic crystals, which he naturally identified as uraninite (pitchblende). Samples were sent to Sir W. Crookes, Sir W. Ramsay, and others, and the whole amount available (some 5 cwt.) was purchased by the latter chemist. Samples were also sent through the Mineralogical Survey to the Imperial Institute for examination and analysis.

In a letter published in *Nature*, p. 510, March 31, 1904, Professor Dunstan published the following analysis of two samples, made by Mr. G. S. Blake at the Imperial Institute :—

I.		II.	
ThO_2	76·22	ThO_2	72·24
CeO_2, La_2O_3, Di_2O_3	8·04	CeO_2	6·39
		La_2O_3 Di_2O_3	0·51
ZrO_2	trace	ZrO_2	3·68
UO_3	12·33	UO_3	11·19
Fe_2O_3	0·35	Fe_2O_3	1·92
PbO	2·87	PbO	2·25
SiO_2	0·12	SiO_2	1·34
		Insol. residue	0·41
	99·93		99·93
S. gr.	9·32	S. gr.	8·98

These analyses showed that the mineral was not pitchblende, and Professor Dunstan suggested the name of *thorianite* for the new mineral.

In a letter in *Nature*, p. 533, April 7, 1904, however, Professor Ramsay published the preliminary results of his examinations, stating that a much smaller percentage of thorium occurred in the mineral, and that no appreciable amount of cerium, lanthanum, and didymium entered into its constitution ; but the presence of one or more new elements was indicated. The mineral was strongly radioactive, but contained only a trace of radium, the radioactivity due to this source being certainly not 5 per cent. of the

total. The period of decay of the emanation appeared to point to the presence of a radioactive element closely resembling thorium X. Helium was yielded when the mineral was heated alone, 3·5 c.c. per gram being obtained ; when fused with hydrogen potassium sulphate, it yielded 9·5 c.c. per gram.

In a subsequent letter (*Nature*, April 14, p. 559) Professor Ramsay admitted that a considerable amount of thoria was present, in addition to the new elements, which may be identical with those recently discovered by Professor Baskerville. A partial analysis which was made in M. Curie's laboratory gave 79 per cent. oxides of rare earths (principally thoria) and 14 per cent. of uranium oxide. A rough preliminary analysis made by Professor Sir W. Ramsay is as follows : oxides like thorium oxide 76·4 ; uranium oxide 14·9 ; ferric oxide 6·1 ; lead, arsenic, &c., 2·0 ; insoluble (not $Si\ O_2$) 0·7. At present the constitution of the new mineral and so also its commercial value cannot be regarded as definitely established ; we must await the completion of further work in London.

With regard to the analyses made at the Imperial Institute I may say that I have not observed any trace of zircon occurring as an impurity in the mineral, and do not think the $Zr\ O_2$ found can be due to the presence of inclusions of zircon, but rather that the zirconia enters into its composition. On the other hand, many crystals have a slight amount of limonite attached to the surface, and even if these be carefully excluded there are others containing small cavities lined with limonite which may in part account for the variations in specific gravity observed, so that a small percentage of iron oxide in the analyses may be regarded as an impurity.

The properties of the mineral not already quoted are referred to below :—Colour black, streak greenish gray. Hardness, 5·5–6. Crystallizes in the cubic system, crystals rarely exceed 7 mm. along a cube edge. Some crystals consisting of two interpenetrating individuals appear to be twins, but this has not been as yet confirmed by measurements. Fracture uneven, tending to conchoidal. Brittle. Lustre resinous to submetallic. Infusible. Dissolves readily in salt of phosphorus bead, vigorously giving off bubbles, doubtless of helium ; the bead in O. F. is yellow when hot, green when cold, being the reaction for uranium. In borax bead yellow hot, pale greenish-yellow cold. Insoluble in acids.

Some account of the localities and mode of occurrence may be given next. The mineral occurs in greatest abundance in loose waterworn crystals in the bed of the Kuda Pandi-oya, a tiny stream near Kondrugala, Bambarabotuwa, Sabaragamuwa, where it often forms the bulk of the heavy residue ("Nambu") remaining in the gemming basket after washing. It collects also in hollows and

potholes in the bed of the stream, which in its upper part is so small as not to contain running water in dry weather. It occurs also in fragments of a ferruginous conglomerate formed in the stream bed, and containing waterworn rock fragments and crystals of zircon, thorite, &c.

The mineral was traced to within a short distance of the head of the ravine, but no sign could be found of any rock containing it *in situ*, and a more extensive search for the matrix would probably be a long and expensive matter, owing to the thick soil, landslips, and thick jungle. I have little doubt, however, that it is derived from some granitic or pegmatite-like rock, such as those in which zircon and allanite have been found.

The mineral was detected in smaller quantities in washings from the Alupola-dola (some distance above the path) and in the Kuda-oya between Batataragala and the said Kondrugala path. Two or three crystals were also seen in gem washings from Massena estate, but more could not be obtained. A single crystal was found in a washing taken from the Pita-ela between Walawe and Morahela estates near Balangoda.

Since uraninite is *rarely* found in cubic crystals, it is most probable that the mineral recorded by me as uraninite from Gampola (*Spolia Zeylanica*, vol. I. part IV., 1904), is in reality the new mineral. It there occurred in a pegmatite consisting mainly of orthoclase, quartz, and biotite, with apatite, tourmaline, &c., as accessory minerals.

I have seen other specimens from Ceylon of a mineral resembling this one, but regarded as uraninite; some of these are massive, and cannot be definitely claimed as uraninite or thorianite without chemical analysis; so that it is far from unlikely that new localities will be found where one or both may be met with in greater abundance.

In the Kuda Pandi-oya it is associated with quantities of zircon (well-developed large crystals, with some excellent twins on e (101)), and with more waterworn crystals of thorite, a mineral which I at first identified as monazite. A crystal of the supposed monazite stated to be from Bambarabotuwa was sent to the Imperial Institute for examination, and Mr. G. S. Blake's analysis gave the following result, the mineral being identified as thorite:—

ThO_2	...	66·26	SiO_2	...	14·10
CeO_2 &c.	...	7·18	H_2O	...	6·40
ZrO_2	...	2·23			
UO_3	...	·46			99·89
Fe_2O_3	...	1·71			
CaO	...	0·35		S. gr.	4·98
P_2O_5	...	1·20			

The form of the crystals, however, shows that the mineral is not tetragonal; it appears to be orthorhombic or monoclinic. The oriented sections which I am having prepared will probably clear up this point. In any case I do not at present regard the mineral as thorite, although its chemical composition is undoubtedly similar to that of thorite.

As has already been pointed out, the occurrence of thorium-bearing minerals (one said to contain a higher percentage of thoria than any mineral previously known) in Ceylon is of great scientific interest, and if they are present in sufficient amount will be of considerable commercial importance owing to the use of thoria for the manufacture of incandescent gas mantles. The 10 or 12 per cent. of uranium oxide alone gives a value of £20 or £30 a ton. The very small amount of radium present is of no practical importance.

II.—Corundum, Sillimanite, &c.

Remarkable corundum-sillimanite rocks were found at Haldummulla (Uva). They occur all down the slope of Haldummulla estate, but not *in situ*, being derived from some point in the inaccessible hill above; the fallen blocks are found as far down as the western end of Kalupahane estate. The minerals sillimanite, corundum, orthoclase-microperthite, garnet, rutile, and ilmenite enter into the composition of these rocks. The principal types met with are: sillimanite-corundum rock, sillimanite-garnet rock, and sillimanite rock; orthoclase-microperthite is present in subordinate and varying amount; ilmenite and rutile are accessory and do not occur together, but mutually replace each other; the corundum and garnet also do not occur together in the same rock. The corundum forms violet-coloured hexagonal crystals, usually less than $\frac{3}{4}$ inch in diameter; the crystals have often a tabular developement, the forms c (0001), a ($11\bar{2}0$), and r ($10\bar{1}1$) are characteristic; rhombohedral cleavage is well developed. The sillimanite occurs in parallel and radiating groups and single individuals, the latter generally idiomorphic (prismatic, giving rectangular cross sections). The crystallization is much coarser than is usual for sillimanite; the largest crystals may reach a length of 2 inches or more and diameter one-tenth inch. The sillimanite has in the rock a pale gray colour, but is colourless in thin flakes. A more detailed account of these rocks will be elsewhere given.

Sillimanite has been met with in the garnetiferous leptynites in some abundance, over a large area between Bandarawela on the one hand and the Bambarabotuwa district (Sabaragamuwa) on the other; also in small amount in a garnetiferous rock found at

Eraporuwa near Kolonna, Sab:. The mineral is exceedingly rare in the Kandy District (where I have only quite recently discovered it ; it is there found (1) in a curious rock from Dulmure, about 7 miles east of Kandy ; this rock may be called *a garnet spinel leptynite* ; and is remarkable for the minute graphic intergrowths of green spinel with felspar which characterize it ; sillimanite also occurs, but very sparingly and is more conspicuous macroscopically than in a thin section ; and (2) in a coarse garnet-leptynite, blocks of which occur by the roadside, but not *in situ*, towards the eastern end of Gregory's road (Upper Lake road, Kandy). In the Uva-Sabaragamuwa District referred to, however, sillimanite is a fairly common and characteristic mineral, though by no means invariably present. The sillimanite-bearing leptynites are characteristic and easily recognized rocks; the colourless, shining, perfectly fresh lath-shaped cleavage surfaces of the sillimanite are very conspicuous in the slightly decomposed granulites. The sillimanite occurs in varying amount, but rarely if ever, however, to the total exclusion of felspar.

III.—Phlogopite.

Particulars of an almost colourless phlogopite mica from Ampitiya, near Kandy, are of sufficient interest to be recorded. The mica is found near a junction of crystalline limestone with granulite (a characteristic situation) ; the exposure is on the north side of the shallow valley between Ketawala hill and the main road about $3\frac{1}{2}$ miles from Kandy. The mica occurs in six-sided, but not very sharp-edged, tabular crystals, not exceeding 4 inches in diameter. A natural parting parallel to the rays of the percussion figure and to the edges of the crystal, is sparingly developed. The optic axial plane coincides with the leading ray of the percussion figure, being thus in the normal position for phlogopite. The rays of the percussion figure are inclined to each other at angles of not quite exactly 60°; the angle K between the two secondary rays (Holland, "Mica Deposits of India," 1902, p. 18, fig. 2) being from 60° to 62°, the other angles 60° to 59°. There are scattered, gray-coloured, hair-like, and very thin lath-like inclusions, which are arranged in directions parallel and perpendicular to the rays of the percussion figure. The axial angle is small, so that the figure in thin flakes is apparently uniaxial and pieces of some thickness must be examined in order to determine the position of the axial plane. In thick pieces the mica has a greenish tinge, and is faintly pleochroic in shades of very pale brownish-green ; thin flakes are quite colourless.

The following analysis was made at the Imperial Institute *:—

Al_2O_3	...	17·88	SiO_2	...	39·39
Fe_2O_3	...	0·21	H_2O	...	3·62
MgO	...	25·86	Moisture	...	0 84
Na_2O	...	1·09			98·79
K_2O	...	9·90			

IV.—Kyanite.

"On Sea-bottoms and Calcretes" J. Lomas, in Professor Herdman's "Report on the Pearl Oyster Fisheries," Roy. Soc., London, 1903.

Kyanite was found by Mr. Lomas as a constituent of sands dredged by Professor Herdman off the coast of Ceylon in 1902; the mineral has not previously been recorded from Ceylon.

In Galle Bay were obtained the minerals, quartz, kyanite, corundum, rutile, tourmaline, and mica; in Trincomalee Bay, quartz (magnetite), garnet, corundum, tourmaline, kyanite, mica; in Palk Bay, quartz, tourmaline, felspar, zircon, corundum, kyanite, mica, ilmenite; in various parts of the Gulf of Mannar, quartz, ilmenite, magnetite, tourmaline, zircon, garnet, kyanite, rutile. These minerals have no doubt, as pointed out by Mr. Lomas, been brought down by rivers from the higher parts of Ceylon, and distributed by currents over the ocean bottom. The absence from these lists of spinel and sillimanite is rather curious.

V.—Chert and Opal.

I have recently shown (Geol. Mag., 1904, Dec. v., Vol. 1, pp. 16–19) that at any rate a part of the chert and opaline rocks which are locally, but in moderate abundance, distributed in the parts of Ceylon with which I am acquainted, are alteration products of crystalline limestones, the carbonates having been removed in solution and replaced by chalcedonic and opaline silica, so that we may find cherts containing the original accessory minerals (spinel, phlogopite, graphite, apatite) of the limestones, but showing no trace of the original carbonates. In other specimens relics of the partially removed carbonates are to be seen. This corresponds to what we know of many cherts that occur amongst sedimentary rocks in England, where it has been shown that the silica (whatever its source) has replaced the original carbonates, which appear to have been corroded and removed in solution. In Ceylon the process appears to have taken place long after the formation of the rock itself.

* I am sorry that the names of the individual chemist or chemists by whom some of the analyses quoted were made have been withheld, and cannot therefore be given.

VI.—Steatite (Talc.)

This mineral occurs in crystalline limestone, or rather dolomite, at Harakgama, Pata Hewaheta, Central Province, both in rounded and ovoid masses less than an inch in diameter, resembling amygdules, and also in small hexagonal prismatic crystals with good basal cleavage, pearly lustre, &c., but terminating irregularly (unlike the rather similar individuals of phlogopite mica in which the basal plane is always well developed). Appearances suggest a secondary origin for the steatite.

VII.—Stilbite.

A rock specimen obtained from Nilhene graphite mine (near Baddegama) some 5 or 6 years ago was covered with small bright transparent crystals. These were examined by Mr. L. J. Spencer, M.A., and found to be stilbite, presenting the forms c (001), b (010), f ($\bar{1}01$), and m (110), and twinned like Dana's figure 3. Stilbite has not previously been recorded from Ceylon.

VIII.—Serendibite.*

This rare mineral, hitherto only known from the moonstone pits at Gangapitiya, Dumbara, Central Province, is found also in the pits at Attaragala near the 11th milepost on the Katugastota-Teldeniya road. The occurrence here is similar to that originally described; the pits are distant from those at Gangapitiya nearly four miles, along the same line of strike.

IX.—Moonstone.

The following is an analysis of Ceylon moonstone (orthoclase felspar) from Gangapitiya, Dumbara, Central Province, made at the Imperial Institute. The material analyzed was clear, colourless, and free from inclusions. The composition is that of an orthoclase rather rich in soda.†

SiO_2	...	65·70	H_2O (combined)	...	0·28
Al_2O_3	...	19·85	H_2O (moisture)	...	0·10
Fe_2O_3	...	0·17			
Na_2O	...	5·20			99·34
K_2O	...	8·04			

* Mim. Mag., vol. XIII., No. 61, 1903.

† It is noteworthy that the analyses of Ceylon orthoclase quoted in Hintze' mineralogy show no soda. The said analyses are, however, quite old.

X.—Kaolin.

A specimen from Alutwela, Teldeniya, Central Province, collected by Mr. James Parsons, was examined at the Imperial Institute with the following results. The material "was of a yellowish pink colour; it contained small quantities of graphite and of ferruginous decomposition products. When mixed with water it furnished a paste which was only slightly plastic. It would only be suitable for the manufacture of common bricks."

Analysis.

SiO_2	...	43·56	H_2O (combined)	...	11·90
Al_2O_3	...	34·77	H_2O (moisture)	...	5·63
Fe_2O_3	...	3·40			
Na_2O	...	0·36			99·90
K_2O	...	0·28			

XI.—Sphene.

This mineral is almost always present in rocks of the Galle group at Galle, and is then sometimes idiomorphic. It is common also in rounded grains in many limestone granulite contact rocks.

Some crystals were observed in a vein of pegmatite exposed in a small graphite pit near Talatu-oya (near Kandy, Central Province), the pegmatite and associated green and white rocks resembling those of Galle, but not containing wollastonite. The pegmatite consisted chiefly of quartz, orthoclase, and pyroxene very coarsely crystallized, with a considerable quantity of graphite in flakes and scales occuping cracks and spaces in the other minerals, and evidently deposited subsequent to their formation. One of the individuals of sphene was measured by Mr. G. F. Herbert Smith and found to present the forms c (001), m (110), and n (111).

XII.—Mispickel.

Mispickel (arsenical pyrite) occurred in a quartz-felspar-tourmaline rock sent in by Mr. W. A. Theobald from Little Valley, Deltota. The material is silvery white, of irregular form, and gives good reactions for arsenic. The greater part of the rock in which it occurs consists of an intergrowth of quartz with black tourmaline—a type not infrequently met with; the presence of felspar (decomposed) is less usual. The arsenical pyrite has not been previously recorded for Ceylon.

REPORT ON PARASITES IN THE CARCASES OF BUFFALOES AT THE COLOMBO SLAUGHTER HOUSE.

CONTENTS.

THE Chairman of the Municipal Council of Colombo having reported that the carcases of many buffaloes slaughtered for meat in Colombo had been found to be infested with parasites in the muscular tissues, His Excellency the Governor appointed a Board in October, 1903, consisting of Dr. A. Willey, Director of the Colombo Museum; Dr. A. J. Chalmers, Registrar of the Ceylon Medical College; and Dr. W. M. Philip, Medical Officer of Health in the Colombo Municipality, to examine and report as to the nature of these parasites.

The subjoined report was duly presented to Government, and is now published by permission of the Hon. the Colonial Secretary, in *Spolia Zeylanica*.

I.—Introduction.

It has been known for some years to the Government and Municipal Veterinary Surgeons and to the Superintendent of the Colombo Slaughter House, that the meat of country-bred buffaloes, and less commonly of Indian buffaloes, is sometimes tainted by the presence of white spindle-shaped parasitic bodies measuring from less than half an inch to more than an inch in length and about a quarter of an inch in diameter across the middle. These bodies lie in the midst of the muscles of which the beef is composed, that is to say, in the voluntary muscles of the body.

The organisms are well known to the native butchers, some of whom have been acquainted with them for nearly forty years. The butchers call them milk-nerves, "pal-narambu" in Tamil, "kiri-nahara" in Sinhalese. The principal consumers of buffalo beef are said to be the Malays who have lived upon this meat for generations.

II.—Identification of the Parasite.

The muscle-parasite of buffaloes is not a flatworm, although it resembles one superficially but belongs to a class of Protozoa, the Sporozoa, so called on account of the method of propagation by spores. Among the Sporozoa it is assigned to the order Sarcosporidia. It is apparently co-specific with *Sarcocystis tenella** which occurs in European ruminants, but on account of its special distribution in Ceylon as a parasite of buffaloes and not of the black cattle of the country, we propose, in accordance with a common practice among systematists to distinguish it by the trinomial term, *Sarcocystis tenella bubali*, which may be conveniently abbreviated to *S. bubali*.

The white bodies which appear prominently among the muscles are cysts protected by two sheaths, an outer nucleated adventitious sheath and an inner non-nucleated, striated *tunica propria*. The cavity of the cyst is divided up into numerous chambers by partitions, the chambers being filled with spores. A zone of proliferation consisting of small chambers may be observed immediately within the tunica followed by ripe chambers turgid with spores. The centre of the cyst is occupied by loose over-ripe chambers containing stale and degenerating spores. A transverse section of a fresh cyst shows an opaque peripheral portion comprising the ripe chambers and a pale translucent central portion consisting of chambers in a state of liquefaction.

When the cysts protrude from a freshly exposed surface of meat it may sometimes be noted after a momentary interval that they have disappeared into the substance of the meat. This is due to passive shrinkage, not to active migration. The cysts are incapable of independent movement although they possess considerable elasticity.

III.—Growth of the Parasite.

The parasite is found in the muscles in two principal stages of development, the one macroscopic (described above), the other microscopic. The microscopic stage can only be found by teasing

* *Cf.* A. E. Shipley, Parasites from Ceylon. Spol. Zeyl., vol. I., part III., p. 45, 1903.

up muscular tissue into its component fibres and examining the preparation with the help of a microscope. We have found it in the striated fibres of the buffalo but only rarely and with considerable pains. It is therefore useless as a diagnostic feature. It occurs within the substance of the individual fibre without otherwise affecting the normal appearance of the latter. Not only

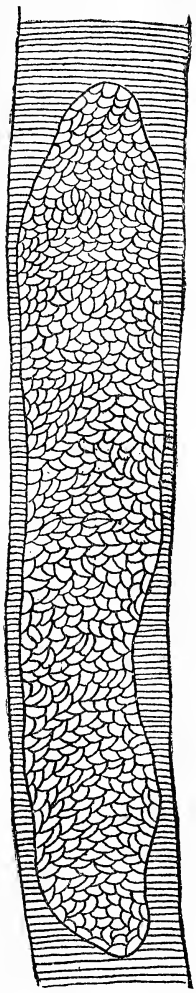

Fig. 1.—Young *Sarcocystis* inside a muscular fibre of the buffalo. Highly magnified; from a preparation stained with thionin.

do the cross striations remain normal beyond the region occupied by the sarcocyst but between the sarcocyst and the sarcolemma or sheath of the muscle-fibre the striations are clearly visible. The youngest sarcocyst which we have observed already contained spores. Sporulation evidently commences at a very early stage after the invasion of the muscle-fibre by the germ.

While within the muscle-fibre the microscopic sarcocyst imbibes nourishment and grows until it distends the fibre to a relatively enormous size, causing the disappearance of the contractile substance of the fibre and retaining around it as an external sheath a small quantity of nucleated sarcoplasm and the sarcolemma. After it has become macroscopic the sarcocyst as a rule still lies in the direction of the grain of the muscles indicative of its origin within a fibre. It often retains the primitive attachments of the original fibre at either end.

Just as the presence of a microscopic cyst within a muscle fibre does not affect the immediate health of the latter, so the presence of the macroscopic cysts even in large numbers has no appreciable effect upon the health of the buffalo.

IV.—Interdiction of Infected Carcases.

The presence of the macroscopic stage of *Sarcosystis* in abundance renders the meat unsightly and repulsive and therefore unmarketable. It is the universal custom among medical and veterinary authorities to condemn badly infected meat, even though a section of the consumers may not object to the presence of the parasitic bodies. Unless buffalo meat is strictly differentiated from black cattle meat on the market, there will always be purchasers of beef who will be horrified by the chance occurrence of a *Sarcocystis*, and whose complaints will not stop at the butchers but will reach to the authorities.

V.—Method of Ascertaining the Presence of the Parasite.

The cysts may be found in all the fleshy parts of the body, including the tongue, muscles of the larynx, œsophagus, and diaphragm; in fact, in all those muscles which are composed of striped fibres. The heart, lungs, and liver are not affected.

In heavily infected cases it has been noticed that the meat is dark, whereas in mild cases there is no change, but this is not an invariable rule, and is probably of little or no significance.

The method of inspection adopted at the slaughter house consists in making deep incisions in the forequarters and hindquarters of the carcase after the hide has been removed. If no sarcocysts are seen to protrude from the cut surfaces the carcase is passed. Should they be present the inspection is carried further and if the infection is found to be general, the carcase is condemned and buried. In cases of mild general infection the carcase is passed.

If the infestation is localized, the part affected is excised and the rest of the carcase is passed, but this does not happen frequently. Occasionally in the case of Indian buffaloes slaughtered in Colombo, sarcocysts have been found only in the tongue, larynx, and œsophagus.

VI.—Diagnosis of the Disease.

It is remarkable that so far as is known the presence of *Sarcocystis* in the muscles of Ceylon buffaloes does not affect the general health of the animals in the slightest perceptible degree. Nevertheless for practical purposes the infected animals may be said to be diseased and the disease is called *Sarcosporidiosis*.

The Municipal Veterinary Surgeon reports that the external appearance, the temperature, the colour of the meat, and the mortality of the buffaloes are normal under all circumstances.

We have not been able to detect any external symptoms by which the presence of the parasite may be inferred during life, and it is quite impossible to avoid slaughtering the infected animals, except by means of a surgical operation which could not be depended upon to yield definite results, and could not be adopted as a measure of practical routine.

VII.—Incidence of Sarcosporidiosis.

From records kept at the Colombo Slaughter House, extending over the months of September and October, 1903, it appears that 858 buffaloes from various districts were slaughtered, 50 of which were registered as infected, 48 being condemned, giving a total incidence of 5·8 per cent. This is not a high percentage.

The details of the records are given in the following table :—

District.	Slaughtered.	Condemned.	Incidence.
Trincomalee ...	31	2	6·5 per cent.
Ratnapura ...	29	1	3 „
Puttalam ...	31	2	6·5 „
Matale ...	16	1	6 „
Kalutara ...	29	2	6·9 „
Tamankaduwa ...	13	5	38 „
Kurunegala ...	180	16	8·8 „
Anuradhapura ...	183	18	9·8 „
Indian buffaloes ...	346	1	0·28 „
	858	48	

It will be seen from the above records that the District of Tamankaduwa in the North-Central Province has yielded the highest percentage of infected cases, and although the actual numbers for the two months are small yet the fact is in

accordance with the experience of the staff at the slaughter-house.

The Municipal Veterinary Surgeon states that "the parasite is more frequently met with in slaughtered buffaloes in the months following the dry season in the districts from which they are brought." This statement, however, requires statistical confirmation or rebuttal.

VIII.—Periodicity.

We have no exact information respecting the possibility of periodical outbreaks of Sarcosporidiosis. The prevailing impression among butchers is that the infestation is perennial.

The Superintendent of the Slaughter House reports that the youngest animal affected in his experience was aged three years and the oldest sixteen years. In a solitary instance of a cow in calf he found that the mother was visibly affected but not the calf. He states further that in his experience the sarcocysts found about the neck tend to be larger than those found elsewhere.

No observations have been made on sucking calves in this connection.

The fact which we have ascertained that the parasite is present in all stages of growth from the microscopic condition within a muscular fibre to its coarse obtrusion in the substance of the meat, shows that the invasion of the fibres takes place more or less continuously.

Unfortunately we have not succeeded in obtaining any certain clue as to the ultimate fate of the mature cysts.

IX.—Dissemination of the Parasite.

In the case of *Sarcocystis muris* which attacks mice, it has been shown by Professor Theobald Smith of Harvard University that healthy mice fed upon the flesh of infected mice contracted the disease, and that the spores entered the host by way of the alimentary tract "in a manner analogous to the transmission of Trichinæ." Their passage from the gullet or gut into the muscular system was not traced. Professor Smith points out that "the life-histories of all Sarcosporidia are not necessarily explained by the results obtained with *Sarcocystis muris*. It would be difficult, for instance, to account for the Sarcosporidia of cattle in the way those of mice can now be accounted for, since cattle are not carnivorous. Their muscle parasite is either an aberrant form from some invertebrate taken in with their food, or else there is an intestinal stage as well which readily permits a discharge of spores outwards."

FIG. 2.—PIECE OF BUFFALO MEAT INFESTED WITH NUMEROUS SARCOCYSTS.

We have instituted feeding experiments upon a dog. After the lapse of several months the dog may be examined, but it is not unlikely that it will be found that the dog is not a facultative host for *S. bubali.**

We are informed by the Municipal Veterinary Surgeon that there is a popular belief among cattle dealers that buffaloes feeding on plantain leaves are liable to contract the disease.

At present the mode in which the parasite is conveyed from host to host or is introduced into any individual host is one of those mysteries of parasitology which await solution in the future. All that is known relates to the endogenous generation within the body of the definitive host. The exogenous generation or phase of development, whatever it may be, remains to be discovered.

X.—Vitality of the Spores of S. bubali.

When a cyst is teased up on a slide in physiological salt solution the spores are set free. They appear as minute crescent-shaped bodies with granular contents and are quite motionless. If the temperature be raised movements of two kinds may be induced, namely, a gliding movement about the centre of their curvature and also a spiral rotation of the body giving the effect of an act of boring. The latter movement is the more important and characteristic. The spores are rounded at both ends, but one end is rather more obtuse than the other, and a faint striation may sometimes he detected here though not always and never very clearly. The blunter end seems to be that which is generally directed forwards in locomotion and a minute protoplasmic rostrum which can be bent to one side or the other can be discerned under high magnification. The body can also be bent slightly and the curvature increased or diminished.

Experiments have been made to determine the conditions and duration of life of the spores when removed from the host. From these it appears that the spores will not resist excessive heat, that is to say, they are killed when the temperature is raised much above the blood-temperature of the buffalo, which represents the optimum temperature for their existence. They will not resist putrefaction nor desiccation and they will not live in running water.

Perhaps the most interesting and suggestive experiments are those in which the cysts were placed in fresh albumen or white of egg and in running water. When cysts are placed in running water they will retain their shape and normal appearance for days, but the spores inside them are killed in about thirty-six hours or in shorter time, and their remains are consumed by infusoria.

* This turned out as predicted.

On the 29th October some cysts were placed in white of egg in a small glass cell which was covered over with a glass plate and rendered approximately air-tight by vaseline. On October 31st the cysts were found to be intact and the spores capable of movement when heated slightly. On 2nd November, the culture was still clear, and the spores normal, moving vigorously on being heated, the movements continuing indefinitely after the source of heat was removed. On 5th November the albumen was slightly clouded by developing schizomycetes, but the cysts appeared unchanged. A similar test with similar results was made by employing milk as the nutritive medium.

The experiments require further amplification, but it would seem that they are sufficient to indicate that, unlike bacteria and infusoria, the spores of *sarcocystis* will not resist hostile influences, but will live for a long time under favourable conditions and in an albuminoid medium. These observations may be useful as a guide to the means by which the parasite is transmitted from one host to another, but they have no further application in the existing state of knowledge.

XI.—Sarcocystis as a Human Parasite.

Sarcocystis has been found in the human subject in a few isolated cases but never as an epidemic.

The few cases in which it has been found in man may rank as clinical curiosities. It has not been recorded as a human parasite in Ceylon. It is not safe to say whether any danger to public health is to be apprehended from the consumption of tainted meat. It is probable, however, that under normal conditions the danger is reduced to a minimum or actually non-existent since the cysts are killed by cooking and their contents transformed into a shapeless coagulum.

ARTHUR WILLEY.
ALBERT J. CHALMERS.
Wm. MARSHALL PHILIP.

Colombo, November 20, 1903.

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DESCRIPTION OF A FROG FROM CEYLON, HITHERTO CONFOUNDED WITH "RANA LIMNOCHARIS."

By G. A. BOULENGER, F.R.S., V.P.Z.S.

MR. E. E. GREEN has pointed out to me, as a result of his observation of living specimens, that two Ceylonese frogs have been confounded by Dr. Günther and myself under the name *Rana gracilis* or *R. limnocharis*. Having also received quite recently, from the Trivandrum Museum, examples of another frog allied to *R. limnocharis*, I have availed myself of the opportunity for revising the specimens thus labelled in the British Museum collection. The frogs of this group are so variable in their characters that it is a difficult task to seize upon the points that may be safely relied upon in diagnosing species. But I think I may conclude that four species may be defined within the series of forms which have usually been designated as *R. limnocharis*, and I have drawn up the following key for their identification. Curiously, these small frogs do not appear at all in Kelaart's *Prodromus*, although both the Ceylonese species are represented in Kelaart's collection in the British Museum :—

I.—Tibio-tarsal articulation not reaching tip of snout. First finger extending beyond second ; toes fully half-webbed ; outer metatarsal tubercle perfectly distinct ; back warty, the warts often confluent into more or less regular longitudinal folds ; male with the sides of the throat black ..... 1. *R. limnocharis*, Boie (*gracilis*, Urigm. ; *agricola*, Jerd.). S. China and Japan to Ceylon and Malay Archipelago.

First finger extending but slightly, if at all, beyond second ; toes not quite half-webbed ; outer metatarsal tubercle indistinct, or confluent with the dermal fold of the outer toe ; back with more or less regular longitudinal folds ; male with the sides of the throat grayish. 2. *R. greenii*, sp. n.

II.—Tibio-tarsal articulation reaching tip of snout or a little beyond ; foot much more than half length of head and body.

Toes half-webbed ..... 3. *R. nilagirica*, Jerd. S. India. Toes barely one-third webbed. 4. *R. brevipalmata*, Peters. S. India.*

*The species was very accurately described by Peters from a specimen purchased as from Pegu. This locality is probably erroneous. The numerous specimens I have seen are from the Nilgherry and Travancore hills.

Rana greenii.

Vomerine teeth in two rather strong oblique series between, and extending posteriorly beyond, the choana. Head as long as broad or a little longer than broad; snout rounded or obtusely pointed, as long as or a little longer than the orbit; canthus rostralis very obtuse, loreal region concave; nostril equally distant from the eye and from the end of the snout; interorbital region a little narrower than the upper eyelid; tympanum distinct, about two-thirds the diameter of the eye. Fingers moderate, with blunt tips, first and second equal, or first extending very slightly beyond second; foot (including inner metatarsal tubercle) more than half as long as head and body; toes rather slender, not quite half-webbed; three phalanges of fourth toe free from the membrane; a small oval inner metatarsal tubercle; outer metatarsal tubercle indistinct, or confluent with the dermal fold of the outer toe. Tibio-tarsal articulation reaching the eye, the nostril, or between the eye and the nostril. Glands on the back forming more or less regular longitudinal folds. Brown above, with black spots, dark vertical bars on the lips, and more or less regular cross-bars on the limbs; hinder side of thighs with dark marblings; a light vertebral stripe constantly present. Male with a vocal sac on each side, forming loose folds on the throat, the sides of which are grayish.

The largest male measures 38 mm. from snout to vent, the largest female 50.

Specimens marked Ceylon (Kelaart, Cuming, W. Ferguson, B. H. Barnes) have long been in the British Museum collection; others, from the hills of Central Ceylon, have been presented by Mr. G. H. K. Thwaites and Mr. E. E. Green.

NOTES ON SOME CEYLON BUTTERFLIES.

By E. Ernest Green, F.E.S.

Government Entomologist, Ceylon.

With Plate and two figures in the text.

1.—Danais alcippus, *Cramer.*

During the rearrangement of the Ceylon butterflies in the Colombo Museum it was found that the collection contained two examples (Nos. 35-36) of *Danais alcippus*, Cramer, distinguishable from *chrysippus* by the broadly white median area of the hind wing. This insect has not previously been recorded from Ceylon. The specimens were taken by Mr. John Pole at Puttalam, where *D. dorippus*, Klug., also fell to the same collector. Both these insects are believed to be varieties or forms of *chrysippus*. In the Journal of the Bombay Nat. Hist. Soc. (vol. XIV., No. 4, p. 716), Manders quotes Butler and Yerbury to the effect that *dorippus* is a form distinctive of Somaliland and Central Africa and that the Indian form should be known as to *D. chrysippus Klugii*.

2.—Melanitis ismene, *Cramer.*

The two forms of this species (*ismene*, Cram., and *determinata*, Butl.) are well marked and show but little tendency to run into each other. They are said—by de Niceville and Manders—to be seasonal forms. Typical *ismene*, distinguished by the highly angled fore wing and non-ocellated or obscurely ocellated underside, is called the dry season form. While *determinata* (Moore as *M. leda*, Linn., in Lep. Cey. The true *leda* is now recognized as a distinct species from Amboina), with unangulated fore wing and prominently ocellated underside uniformly covered with dark strigæ, is the reputed wet season form. My experience is that the two forms occur promiscuously in Ceylon. I have, this very month (February), in the middle of the dry season, taken both forms on the same date in my garden at Peradeniya. The markings of the underside of the form *ismene* are very variable. Figure 5 on the plate shows a partial exception as regards the ocellate spots, but the highly angled fore wing determines its position in the dry season series.

M. ismene is an adept at concealing itself. It usually pitches amongst fallen leaves where its form and coloration are sufficient concealment. But even on bare ground the insect is often extremely difficult to localize, though the approximate spot may have been carefully noted. I have watched the fly, immediately after pitching, alter its position so that its axis is directed towards the sun, thus casting no shadow.

3.—Cynthia asela, *Moore.*

The Museum collection (No. 395) contains an unique aberration of the male of this species, taken by the writer at Haragama (Central Province), December, 1902. The ground colour is of the normal tint, but all definite lines streaks and spots have either completely disappeared or been replaced by nebulous fasciæ (see fig. 1).

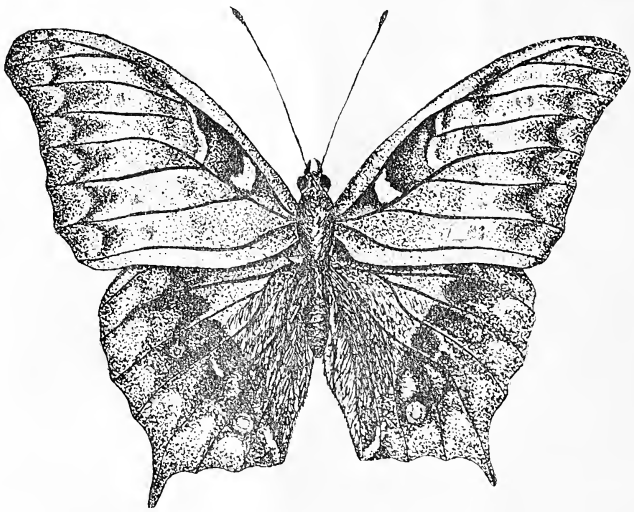
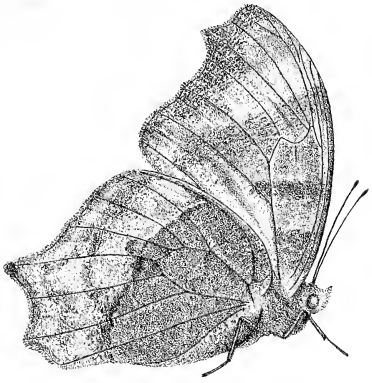


Fig. 1.—*Cynthia asela,* Moore.

Upperside: fore wing bright yellowish fulvous, darkest on basal area and outer margin. The cell, with the exception of a median bar of the ground tint, is filled in with fuscous. The two marginal sinuous lines are replaced by a single series of diffused arches between the veins, the apex of each arch confluent with a deep fulvous ovoid nebulous spot. Other lines absent. Hind wing deep yellowish fulvous, with a broad diffused fuscous discal bar crossed by the pale nervules, this fuscous bar taking the place of the lighter area in typical examples. The usual ocelli are replaced by diffused whitish spots. The median and marginal lines are totally absent. Underside yellowish fulvous; the basal area suffused with ochreous pink. All definite lines absent. The cell markings as on upperside. A diffused white



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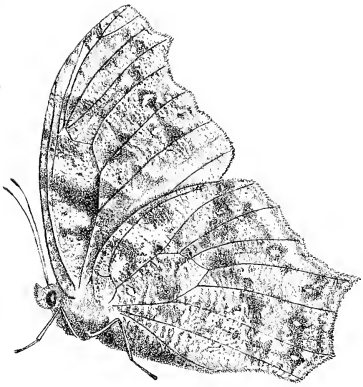

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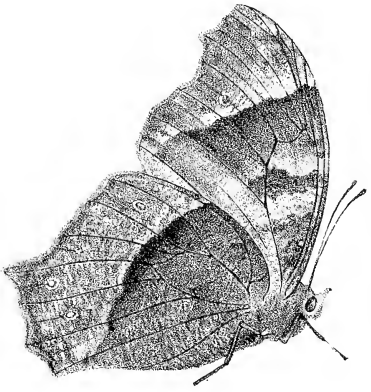

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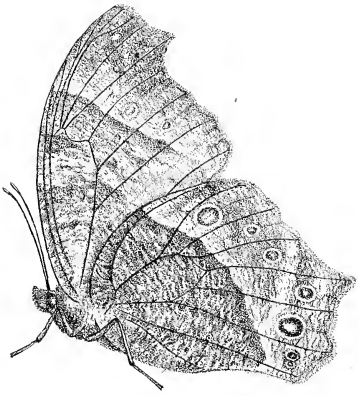

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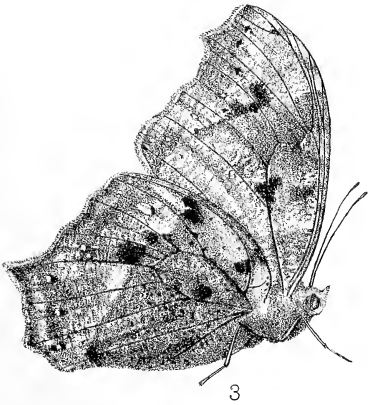

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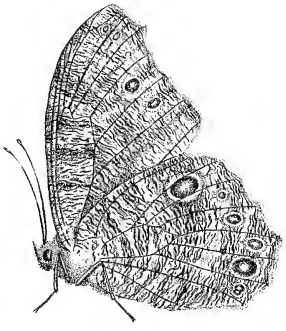

6

E.E.Green del.

West, Newman lith.

MELANITIS ISMENE.
VARIATIONS. *Green*.

spot near apex of fore wing and two similar spots on sub-marginal area of hind wing. Median fuscous bar on hind wing more restricted than on upperside. Some indistinct nebulous ochreous fasciæ on disc of both wings.

Marshall and de Niceville mention no varieties or aberrations in connection with *C. asela*, which is a remarkably constant species. I have seen no other variation from the typical form.

4.—Zizera otis, *Fabricius.*

An aberrant female in the Museum collection (No. 637) has the upperside normal, but on the underside the usual curved series of spots on both wings is extended outwards to the sub-marginal line, forming a series of elongated streaks (fig. 2). (Taken by the writer at Peradeniya, July, 1900.)

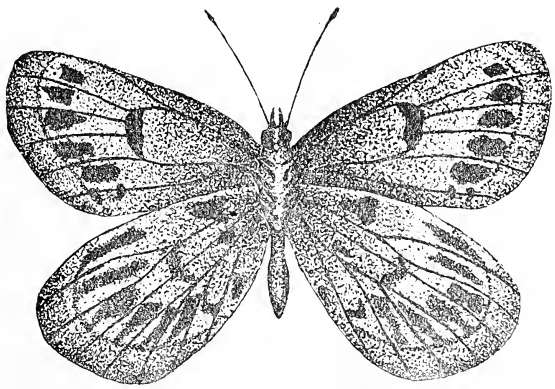

Fig. 2.—*Zizera otis*, Fabricius. Seen from below.

5.—Talicada nyseus, *Guerin.*

The Museum possesses a single specimen (No. 660) in which the usual scarlet patch on upper surface of hind wing is replaced by creamy white. On the under surface, the usual outer series of black spots on the hind wing are wanting and the red band is replaced by pale ochreous. This specimen, with one other similarly aberrant, was taken by Mr. John Pole at Trincomalee.

EXPLANATION OF THE PLATE

Illustrating Mr. E. E. Green's Notes on some Ceylon Butterflies.

All the figures relate to *Melanitis ismene*, Cramer.

Figs. 1 to 5 show some of the principal variations of the typical or dry season form.

Fig. 6 represents the form *determinata*, Butler.

OBSERVATIONS ON THE HÆMATOZOA OF VERTEBRATES IN CEYLON.

(*A Preliminary Note.*)

By

ALDO CASTELLANI, M.D.,
Director of the Bacteriological Institute, Colombo.

and

ARTHUR WILLEY, F.R.S.,
Director of the Colombo Museum.

With Plate.

INTRODUCTION.

THE investigations into the parasitology of the blood have yielded such great results within the last ten years, important alike from the point of view of practical medicine and from that of pure biology, that no apology is needed for the present contribution to the very extensive literature of the subject, especially because no systematic work of the kind has yet proceeded from the Island of Ceylon.

The microscopic organisms (apart from bacteria) which more or less frequently infest the blood of certain vertebrates belong to two different branches of the animal kingdom, namely, the nemathelminthes (nematoda) or thread-worms and the protozoa or unicellular animals.

The protozoan hæmatozoa belong to two distinct classes, firstly the sporozoa, which are predominantly endoglobular, living at least throughout the first period of their growth within the substance of the individual blood-corpuscles from which they or their progeny can emerge under certain circumstances and at certain periods; secondly, the flagellata which swim about freely in the plasma of the blood.

The parasitic infection of the blood due to the presence therein of minute thread-worms is called filariasis; that due to the flagellata is called trypanosomosis; and the sporozoan infection is termed hæmosporidiosis.

The dreaded human malaria comprises the particular forms in which hæmosporidiosis manifests itself in man. Another form of

the disease which commonly occurs in cattle is known as piroplasmosis.

In the cases of man and the domestic animals it is the practice, in different countries and districts, to give local names to the maladies occasioned by the various parasites.

Filariasis.

Filaria mansoni, n. sp.

The presence of blood-filariæ in this island has been previously recorded for man* and the crow.†

We have further to note that in the blood of a cachectic pariah dog examined recently several filaria embryos were found strongly resembling those of *Filaria immitis*, to which species we think they probably belong. In preparations stained with hæmatoxylin and eosin the parasites presented no sheath, the tail was pointed, the body not very granular, almost homogeneous; the length was about 0·12 mm.

The filariæ which live in the blood are embryos produced by adult females which may be found somewhere imbedded in the tissues of the host. It is known that the species of the genus *Filaria* occur especially in mammals and birds, that it is to say in warm-blooded vertebrates. But not all species give rise to blood-filariæ.

We have now to describe an interesting case of filariasis of a cold-blooded reptile, the Brahminy Lizard, *Mabuia carinata*.‡ In the blood of a mature female lizard of this species captured in Colombo in July, 1904, we observed numerous filariæ slowly wriggling, measuring about six or seven times the length of a blood-corpuscle.

The wriggling consists in serpentine undulations of the body which do not involve much change of position and, in a fresh preparation for example, the little worms do not dart across the field of the microscope. They appear as whitish bodies when alive in the blood, cylindrical in shape, rounded at both ends, and destitute of any obvious differentiation. They are relatively rather stout, about half as thick again or nearly twice as thick as the linear embryos at the time of their extrusion from the body of the parent.

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* Manson, P. Tropical Diseases. London, 1900, p. 483. Of 55 cases examined one yielded *Filaria nocturna*.

† See this Journal, Part II., June, 1903, p. 28; and Part IV., p. 103 (*Filaria vivipara*, Linstow, in the gray crow, *Corvus splendens*).

‡ Called "hikanella" in Sinhalese; "aranai" in Tamil.

In dried blood-films fixed in absolute alcohol and stained with hæmatoxylin and eosin, the body of the organism is found to have contracted within its cuticular sheath, leaving a faintly bluish-stained membrane projecting at each end of the body. When prepared according to Leishman's modification of Romanowsky's method, the sheath remains colourless. In stained preparations the tail of the body inside the sheath ends bluntly, but is more attenuated than the anterior portion. The length of the body without the sheath is ·09 mm., with the sheath ·14 mm.

Two adult females were found imbedded in the musculature of the body wall, one in the ventro-lateral abdominal region, the other in the dorsal wall of the body-cavity. The former was loosely coiled upon itself, the latter appeared as a deeply winding white clew (*cf.* fig. 1).

The tail is attenuated and bent round; at its extremity there is a rounded knob, shortly in front of which the vent lies on the ventral side (fig. 2). The head is slightly spatulate, with a sense-organ on each side near the front; the mouth is terminal, leading into a buccal capsule from which a short vestibule leads back to the œsophagus (fig. 3); the latter is ·53 mm. long or $\frac{1}{71}$ of the total length. The adult worm measures 38 mm. in length by ·5 mm. in breadth.

For this species, which we take to be new, we propose the name of *Filaria mansoni* in honour of the distinguished authority on parasitic tropical diseases—Sir Patrick Manson.

When removed from the body of the host and placed in dilute formalin both adult specimens discharged a large number of eggs and embryos into the fluid, from the generative orifice which is situated near the anterior end of the body (fig. 4).

Trypanosomosis.

Trypanosoma lewisi (Sav. Kent).

Under this heading we have to record the occurrence of *Trypanosoma lewisi* in the house-rats (*Mus decumanus*) of Colombo. Probably at least 25 per cent. of adult rats are infected. In Bombay Dr. Hanna has noted that 12 per cent. of the rats harbour the parasite.

The number of parasites varies in different hosts. Sometimes they are so numerous, the lashings of the flagellum so powerful, and the rapidity of their movements so great, that the blood appears to be seething with them. Dr. Hanna* has found other

* Hanna, W. Trypanosoma in Birds in India. Quart. Journ. Micro. Sc. vol. 47, 1903, pp. 433–438, pl. 32.

species of *Trypanosoma* in the domestic pigeon in India and in the Indian crow. The domestic pigeon was also found to be affected with the hæmamœba, *Halteridium danilewskyi* (see below), but it is not quite clear whether the two parasites were present in one and the same host.

We have not yet come upon *Trypanosoma* in Ceylon elsewhere than in the rats of Colombo.

Trypanosoma lewisi is apparently a non-pathogenic parasite, its presence in millions in the blood not affecting the health of the host. It has been shown that this species has become split up into two physiologically different races indistinguishable morphologically, namely, the parasites of rats and the parasites of the Hamster (*Cricetus frumentarius.*). Although these parasites are identical in form and properties, yet an inoculation of the one parasite into the host of the other never takes effect.*

It appears that Koch (1898) was the first to demonstrate that the *Trypanosoma* of the Nagama disease of cattle, *T. brucii*, could be transmitted by inoculation into rats and other animals, while the rat parasites are only transmissible to rats.

Bradford and Plimmer (Quart. Journ. Micr. Sc. vol. 45, 1902, p. 450, &c.), found that sewer rats naturally infected with *T. lewisi* were not immune against the fatal effects of *T. brucii* when introduced into their blood by inoculation, but that they died in the usual time, five days after inoculation.

Rabinowitsch and Kempner showed that rat-trypanosome is transmissible to white rats by inoculation, but these exhibit no tendency to spontaneous infection. The same authors also ascertained experimentally that rat-trypanosomes can be transmitted from one host to another by fleas, a discovery which was confirmed by Laveran and Mesnil.†

We may add some brief notes on the action of various chemical substances on *Trypanosoma lewisi*.

For these experiments a small loopful of trypanosoma-infected blood was mixed with the same quantity of the chemical, the action of which we wished to test. Hanging drop preparations were made, carefully sealed with vaseline. All the experiments were performed at the temperature of the room (about 87°

* v. Wasielewski and Senn. Beiträge zur Kenntniss der Flagellaten des Rattenblutes. Zeitschr. f. Hygiene und Infectionskrankheiten. Bd. 33, 1900, pp. 444–472, Taf. VII.—IX., see p. 458.

† *Cf.* Lydia Rabinowitsch and W. Kempner, Die Trypanosomen in der Menschen- und Tierpathologie, sowie vergleichende Trypanosomenuntersuchungen. Centralbl. Bakt. Parasit. Abth. 1. Bd. 34, 1903, pp. 804–822. This Paper includes a very full bibliography of Trypanosomosis.

F. to 97° F.). The results are collected in the following table :—

Chemical Substance tested.	Time of Observation.			
	30′	3 hours	7 hours	22 hours.
Blood without addition of any chemical ...	++	++	+	The preparations do not show any trypanosomes either motile or non-motile.
Salt solution, 1 per cent.	++	++	+	
Distilled water	++	++	+	
Tap water	++	+	+	
Iron perchloride, 1 per cent. ...	+	—	—	
Lugol's liquid	+	—	—	
Sublimate, $\frac{1}{1000}$	—	—	—	
Vesuvin Brown, 1 per cent.... ...	++	+	+	
Vesuvin Brown, $\frac{1}{1000}$ ...	++	+	+	
Methyl green, 1 per cent.	++	—	—	
Methyl green $\frac{1}{1000}$	++	+	+	
Gentian violet, 1 per cent.	—	—	—	
Gentian violet, $\frac{1}{1000}$	+	—	—	
Methylene blue 1 per cent.	—	—	—	
Methylene blue, $\frac{1}{500}$	—	—	—	
Methylene blue, $\frac{1}{10000}$	—	—	—	
Methylene blue, $\frac{1}{100000}$	+	+	—	

The sign ++ means that the parasite is actively motile ; the sign + means that the parasite is sluggishly motile ; the sign — means that the parasite has lost its motility.

The Table shows that some staining substances have a very marked action on the vitality of the parasite. Of all the stains tested the methylene blue acted most effectively. A 1 per cent. solution of methylene blue stops at once the movements of the trypanosomes, which appear blue-stained and with their shape well preserved. Such results would suggest the use of inoculations of methylene blue (chromotherapy) in animals and man affected with trypanosomosis, inasmuch as methylene blue is little poisonous. Manson and Low,* however, have tried methylene blue inoculations in a man affected with trypanosomosis without getting any good result. Recently Ehrlich and Shiga† have had good results in animals by inoculations of a solution of a new stain which on account of its great affinity for the trypanosome they have called *Tryparoth*.

HÆMOSPORIDIOSIS.

The classification of the Sporozoan parasites of the blood is not yet quite fixed, but for present purposes, following Laveran's

* Brit. Med. Journal, 1904.

† Chromotherapeutical researches on trypanosomosis. Berlin Klinische Wochenschr., March 28 and April 4, 1904. Reviewed in Annali di Medicina navale X. 1904, p. 781.

distribution of the genera,* three families may be recognized :— Hæmamœbidæ, comprising the malarial parasites of man, apes, bats, and birds ; Piroplasmidæ, comprising the parasites causing Cattle fevers (Texas fever, Rhodesia fever, &c.); lastly, the Hæmogregarinidæ, including a large assemblage of endoglobular parasites of fishes, amphibia, and reptiles.

We now pass on to summarize our own observations on these organisms.

HÆMAMŒBIDÆ.

Halteridium danilewskyi (Grassi and Feletti).

This parasite has been described from many birds in different countries. All are regarded as belonging to the same species.

The blood of a common Scops Owl (*Scops bakkamœna* var. *malabaricus*) taken recently (July) in Colombo proved to be abundantly affected by it. Only endoglobular phases were with certainty observed by us, and these showed the sexual differentiation of the trophozoites† already noted by MacAllum. In our preparations there are two kinds of fully developed trophozoites, present in approximately equal numbers, perhaps rather more of the first kind than of the second. In one form the protoplasm is stained distinctly blue with Leishman's mixture, leaving a clear tract in the centre, pigment granules being scattered more or less throughout the protoplasm. These, according to MacAllum (as quoted by Minchin), are characters of the female parasite.

The second type shows characters of the male. It has generally a shorter and stouter form, appearing nearly white, very faintly bluish white, owing to greater density of the protoplasm, and the pigment-granules are aggregated at the two ends. In one instance we observed a double infection of a blood-corpuscle by the two forms (fig. 7). There are indications that the granular or female parasite undergoes amœboid movements. Young oval stages of the trophozoite are also present though not common.

The conversion of the male trophozoite into a gametocyte can be followed in our stained preparations. The parasite becomes shorter, thicker, and finally nearly round (fig. 9).

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* *Cf.* Minchin, E. A., Sporozoa, in A Treatise of Zoology, edited by Professor E. Ray Lankester, Part I., Fascicle 2, 1903, p. 265.

† The terminology employed here is based upon that laid down by Professor Minchin in the treatise to which we have already referred. The parasite grows in the blood-corpuscle from a minute germ to its full size. During this stage of endoglobular growth the parasite is called a trophozoite. When a trophozoite becomes sexually mature it is called a gametocyte. MacAllum's original papers published in the Journal of Experimental Medicine, vol. III., 1898, have not been accessible to us.

Further observations on this particular case of *Halteridium* infection were cut short by the untimely death of the bird, which apparently fell a victim to some beast of prey during the night.

Halteridium is a non-pathogenic parasite. (See additional note at end of paper).

Hæmocystidium simondi, n. g. et sp.

In the blood of a tree-dwelling gecko, *Hemidactylus leschenaultii*, taken at Mamadu near Vavuniya (Northern Province) in April of this year we have discovered an interesting pigmented endoglobular parasite which cannot be placed in any hitherto described genus of hæmamœbidæ. It consists at the earliest observed stage of a small rather irregular or amœboid body with a zone of pigment granules across the centre. At first the nucleus of the blood-corpuscle is only slightly displaced (fig. 10).

The growth of the parasite leads to further displacement of the nucleus of the host-cell which becomes pushed to one end of the corpuscle. Sometimes the parasite is oval or somewhat irregular in contour ; sometimes it is round or lenticular. The elongated oval form nearly fills the corpuscle, only a narrow pink rim may be seen surrounding the blue body which moulds itself upon the nucleus of the blood-cell. Judging from the analogy of other cases it would seem that the spherical or discoidal form is the gametocyte or final stage of the trophozoite.

In our preparations there are two very distinct types resembling each other in form, but differing in their reactions to Leishman's stain. These no doubt represent sexual differences as in *Halteridium* and in other previously known cases.

In the male type the body is faintly granular and stained a delicate pale blue, with small numerous pigment granules scattered round the periphery. In the other or female trophozoite the body is stained dark blue, the pigment granules though numerous appear to be slightly larger at times ; and varying numbers of vacuoles of different sizes are always present. In the pale form vacuoles never occur (figs. 12–13).

We propose to name the new genus with the characters which we have described, *Hæmocystidium*, on account of its rounded, turgid, more or less bladder-like shape and appearance. The specific name is dedicated to Dr. P. L. Simond who has described a somewhat similar parasite, though of a different species, from *Trionyx indicus*, a fresh water tortoise common in the Ganges and Jumna.*

* Dr. P. L. Simond, Contribution a l'étude des Hématozoaires endoglobulaires des Reptiles. Ann. Inst. Pasteur T XV., 1901, pp. 319–350, see p. 338.

Dr. Simond named the species observed by him *Hæmamœba metchnikovi*. While resembling our parasite in general features it differs in size, rarely exceeding the half of the blood-corpuscle, in the smaller number of its pigment granules, and in the fact that it does not cause a displacement of the nucleus of the corpuscle according to Dr. Simond's figures.

A good demonstration of the difference in size between the two species is afforded by the effect of double infection. In the case of *H. metchnikovi* Dr. Simond has figured a corpuscle, otherwise normal, containing two parasites, male and female (Simond, *l.c.*, pl. VIII., fig. 14*b*). In a doubly infected corpuscle observed by us the growth of the two trophozoites had caused a deep constriction of the corpuscle, almost cutting it in two (fig. 16).

It seems clear that *Hæmamœba metchnikovi* belongs to our genus *Hæmocystidium*, and it should henceforth be styled *Hæmocystidium metchnikovi* (Simond). The name *Hæmocystidium* will probably be found of use as a distinctive term, but until all the stages of the life-history of the parasite are known it can only be regarded as a provisional designation.

HÆMOGREGARINIDÆ.

Hæmogregarina nicoriæ, n. sp.

The species of the genus *Hæmogregarina* are often difficult to distinguish from each other and the principal and most obvious means of differentiating them is by host and locality. Our brief account of the above-named parasite will add little to the knowledge of the hæmogregarines beyond indicating a new distribution.

The larger specimens of the tortoise commonly met with in ditches and marshy lands round Colombo and in the Colombo lake, *Nicoria trijuga*, appear generally to be infected with a non-pathogenic hæmogregarine which does not betray any highly distinctive properties.

When examined in the fresh condition the crescent-shaped or reniform body of the parasite presents one clear pole, one granular pole, and a clear but sharply defined central tract which in stained preparations proves to contain the nucleus. More frequently than not the clear pole is directed towards the nucleus of the blood-corpuscle, but there is no constant orientation.

The granular pole is the growing end of the organism which becomes bent round upon itself in the manner characteristic of the genus *Hæmogregarina*. The doubling of the parasite usually takes place by a very narrow bend, but occasionally a wide bight is produced (fig. 19). Young stages before the bending came

under our observation in both fresh and stained preparations. We have also observed a double infection (fig. 21).

The nucleus appears as a more or less diffuse aggregation of chromatin granules which sometimes extend to the recurved limb of the parasite. The length of the bent parasite is ·01 mm.

In one case the parasite has apparently unbent itself inside the corpuscle (fig. 23).

In a hanging drop prepared from the blood of a specimen which had been killed some hours previously we have once only observed a motile parasite free in the blood-plasma. The movements consisted of slow revolutions in the arc of the parasite and also of movements of flexion. The granular pole was directed forwards and the other pole appeared to be more or less fixed or adhesive. Finally the parasite was attracted by an irresistible chemotaxis to a neighbouring phagocyte by which it was gradually absorbed.

In other cases we have found the bent forms free in the plasma, but we attribute this to accident.

The free motile form observed is apparently simply a trophozoite which has issued from the corpuscle and become free. The corpuscle may have undergone liquefaction, thus liberating its inquiline. Such free primary trophozoites have been described for *H. stepanovi* by Laveran* and for *H. hankini* by Simond and perhaps for other cases. Our reason for particularizing on this matter will be evident from what follows in the next section of this paper.

Other endoglobular parasites of Chelonians are *H. stepanovi*, Danilewsky, from *Emys* and *Cistudo; H. labbéi* Börner†, from *Platemys* and *Clemmys*; *H. mesnili*, Simond, from *Emys tectum; H. laverani*, Simond, from *Cryptopus granosus* (= *Emyda granosa*); *H. billeti*, Simond,‡ from *Trionyx stellatus*.

Hæmogregarina mirabilis n.sp.

1.—Endoglobular Infection.

A young water snake, *Tropidonotus piscator*, 2 feet 1½ inch long, recently examined in Colombo, was found to be moderately infected with a hæmogregarine the trophozoites of which were approximately at the same phase of growth, more or less bent into a U-shape in the usual hæmogregarine manner.

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* *Cf.* Minchin, E. A., *op. cit.*, p. 266.

† Carl Börner, Untersuchungen über Hämosporidien, I. Ein Beitrag zur Kenntnis des Genus Hæmogregarina, Danilewsky. Zeitschr. wiss. Zool. Bd. 69, 1901, pp. 398–416.

‡ Simond, *op. cit.*, p 338, footnote.

These trophozoites present slight differences from those of *H. nicoriæ*. Their size is rather larger, 12 microns (·012 mm.) in length, the protoplasm stains a uniform blue leaving no clear pole, the reddish-blue stained nucleus is denser and is placed near the anterior pole. The greater density of the nucleus is evidenced not only by the closer aggregation of its chromatin material, but also by a greater resistance to the staining reagent. In many instances the nucleus of the parasite is hardly or not stained at all. If the parasite has been artificially set free on the slide, its nucleus is certain to be well stained.

It should perhaps be noted that the host-snake had died some hours before the examination of its blood, but this fact had nothing to do with the presence of the trophozoites.

The latter when kept fresh under observation in a hanging drop for several days undergo no apparent change until they disintegrate.

2.—Free Infection.

We do not know the fate of the U-shaped trophozoites described above, nor do we know how long they remain in a particular phase of growth within the corpuscle. Just as they remain unchanged for days in a hanging drop, so they may live for months without undergoing much appreciable change within the blood-cells of the host.

At last there comes a crisis in the life of the parasite when something must happen to perpetuate its existence. There are several critical stages in the life cycle of other Hæmosporidia and the same fact probably holds true for the Hæmogregarines, only here the stages have not been properly defined. A form of reproduction by multiple fission resulting in the formation of eight daughter trophozoites or merozoites has been described by Laveran* (*cf.* fig. 22, *H. nicoriae*).

A few days after the endoglobular parasites had been found in the young *Tropidonotus* a very large freshly killed snake of the same species came into our hands.† A hasty examination of a drop of blood revealed the presence of extraordinary numbers of free, actively moving hæmogregarines in the blood-plasma. Numerically this invasion would compare favourably with a rich infiltration of *Trypanosoma*, a comparison which is all the more appropriate on account of the activity of movement and the disturbance created among the corpuscles. The analogy is still further strengthened by the behaviour of these highly motile

* *Cf.* Minchin, E.A., *op. cit.*, p. 266, fig. 77 j.

† Its length was 3 feet 8 inches, and its girth more than twice that of the younger specimen.

bodies in the hanging drop. When kept under observation in this condition it has been found by various investigators that the development of *Trypanosoma* ceases even at the blood-temperature,* and sooner or later the parasite becomes completely dissolved.

So it happens with the free hæmogregarines of *H. mirabilis*. Several hanging drops were prepared towards six o'clock in the evening. On the following morning not a trace of the parasites was to be found beyond here and there some questionable granular matter. The blood-corpuscles remained perfectly normal. As mentioned above, the endoglobular parasite undergoes no such rapid dissolution, but persists as long as the corpuscle which harbours it.

The movements of our free hæmogregarine consist of gliding slowly along and turning, sometimes bending double upon itself. Then again an individual will appear fixed at one spot by its more attenuated hinder end and will revolve by a rather slow screw-like motion like the spores of *Sarcocystis*. Then will appear a very rapid whirling of the body displacing the neighbouring corpuscles. This last movement, as later observations on stained preparations showed, was probably due to the efforts of the parasite to free itself from the corpuscle.

The most remarkable and as we believe hitherto undescribed fact in connection with these parasites relates to their origin within the blood corpuscle. This is shown in our preparations (stained by Romanowsky's method) in the clearest manner.

Many of the corpuscles contain parasites of relatively large size and lightly crescentic or reniform in shape consisting of a delicate membrane, closely applied to which are more or less distinct rows of red-stained granules uniformly distributed. The centre of this body, along its entire length, is occupied by a pale blue-stained body containing a well-defined densely staining nucleus. The enveloping body is the mother-cell of the contained body and in the following description we will refer to it as the *cytocyst*. The single organism which the cytocyst produces escapes from the membrane and from the corpuscle, and becomes the freely motile parasite described above from life. We will call it a *monozoite*, and the cytocyst is a monozoic cytocyst.

The nucleus of the monozoite lies behind the centre of the body both before and after its birth. Our preparations show all stages of emergence of the monozoite. When fully formed within the cytocyst, the hinder end of the monozoite is slightly bent, indicating that a certain pressure is exerted on the cytocyst,

* *Cf.* v. Wasielewski and Senn., *op. cit.*, p. 451. See also above p. 82.

or in other words that the monozoite exists in a state of tension.

In the next stage the anterior end of the monozoite (always the anterior end) is found to have perforated the wall of the cytocyst and begins to push its way out through the opening thus produced (figs. 30–35).

In some cases at the moment of fixation of the blood-film on the slide the monozoite had extruded its body as far as the middle of the nucleus which appears constricted. In other instances only the hinder end lies still within the cytocyst and corpuscle, the rest of the body being free. Sometimes instead of emerging from the corpuscle the monozoite comes out of the cytocyst into the substance of the corpuscle (fig. 33). We regard this as an abnormal condition.

Occasionally the cytocyst membrane is difficult to distinguish, and the monozoite appears to lie in the corpuscle without a sheath. In such cases the membrane can often be identified on close inspection, but sometimes no trace of it can be seen. The preparations here and there show some indications of an attempt on the part of a monozoite to re-enter the corpuscle. This may sometimes happen.

Growth Forms.

According to our observations the monozoites which emerge from the cytocysts are all of the same size within the limits of a slight variation.

In the plasma of the blood some are much larger than others, especially in point of width (figs. 36–37). The staining reactions of all are the same, namely, pale blue cytoplasm and dense reddish-blue nucleus.

In a few rare instances we have observed stages in the formation of the monozoite within the cytocyst. In these cases the condensation of protoplasm is incomplete, the pale-blue merging imperceptibly into the substance of the cytocyst. Above all the nucleus shows unmistakable signs of formative activity in the definite distribution of its chromatin (fig. 29).

Involution Forms.

In a few corpuscles we have found bodies which are apparently monozoites undergoing degeneration. The nucleus appears to be fairly normal, but the cell protoplasm (cytoplasm) is reduced and sometimes indefinite (fig. 38). Such cases may possibly be due to some mischance, such as the re-entry of a monozoite into a corpuscle of the same host.

When the monozoite has issued in the usual way from the cytocyst the latter remains within the corpuscle, sometimes showing a slight crumpling due to collapse of the membrane. The corpuscle becomes enlarged about twice the normal size, and its cytoplasm appears pale as if undergoing dissolution, which indeed is obviously the case.

We have not been able to follow the stages in the involution of the cytocyst, but we do not doubt that it eventually disintegrates as its term of service has clearly expired. In one case only have we found a corpuscle which appears to contain the ghost of a cytocyst.

With regard to the red-stained granules of the cytocyst, we regard these as belonging to a thin layer of residual protoplasm which is left round the periphery of the mother-cell after the formation of the axial monozoite. Sometimes the portion of the issuing parasite which has already emerged from the cytocyst appears reddish outside, the portion inside the sheath being pale blue. This would seem to be due to a slight amount of the residual protoplasm being carried out by the monozoite; or perhaps the cytoplasm of the corpuscle may be involved as well.

Conclusion.

We shall not attempt to discuss in detail the nature of the various forms we have described, believing that the observations in themselves are sufficiently striking to warrant publication.

Of course there is the question of the genetic connection between the trophozoites of the first or endoglobular infection and the cytocysts and monozoites of the free infection. The evidence that they belong to the cycle of development of one and the same species is only presumptive.

First of all there are the facts of the specific identity of the hosts, of the close proximity (within the radius of a few miles) of the localities, the fact that the parasites belong to the family Hæmogregarinidæ, and lastly the circumstance of the approximately synchronous development of the parasites in their respective hosts, the trophozoites of the endoglobular infection presenting the same phase of growth within narrow limits and the cytocysts of the free infection varying only within the limits of the origin and birth of the monozoites.

As for the motile monozoites, their fate remains for the present a mystery and we will only hazard the suggestion that they represent fully developed forms ripe for transmission to another host.

Supplementary Note on Halteridium.

Quite recently it has been announced by Dr. Fritz Schaudinn that *Halteridium* is to be regarded as the sexual phase in the life-history of a *Trypanosoma*. This is a most surprising discovery, and cannot fail to lead to further unexpected developments. [Schaudinn, F. Generations-und Wirtswechsel bei Trypanosoma und Spirochaete. Arbeiten aus dem Kaiserl. Gesundheitsamt, Berlin. Bd. XX., Heft 3, 1904. Abstract by H. Kossel in Archiv für Schiffs-und Tropen-Hygiene, Bd. VIII., 1904, p. 173.]

EXPLANATION OF THE PLATE

Illustrating the Article on the Hæmatozoa of Ceylon, by Drs. Castellani and Willey.

Fig. 1.—*Filaria mansoni* ♀. Drawn after preservation. × 4.

Fig. 2.—Same. Tail end with indication of vent. 4D cam. luc.

Fig. 3.—Same. Head end. × 30.

Fig. 4.—Same. Outline sketch of anterior end showing the discharge of the eggs.

Fig. 5.—Same. Linear embryo discharged into the preserving uid. 4 D cam. luc.

Fig. 6.—Same. Blood-filaria from a stained preparation. Oc. 3. Obj. $\frac{1}{12}$ oil imm. cam. luc.

Fig. 7.—*Halteridium danilewskyi.* Double infection of a blood corpuscle. The nucleus of the corpuscle is drawn in outline only in this and the following figures. The black spots in the parasites are pigment granules.

Fig. 8.—Same. The parasite shows an interruption at the centre, and its ends are bifurcated with a refringent granule in each process.

Fig. 9.—Same. Male parasite becoming short and round.

Fig. 10.—*Hæmocystidium simondi.* Young male trophozoite in corpuscle, staining pale blue, with zone of pigment spots. Compensating oc. 4. obj. $\frac{1}{12}$ cam. luc.

Fig. 11.—Same. Young female trophozoite, staining dark blue, with pigment spots and one vacuole; shape amœboid. Same magnification as fig. 10.

Fig. 12.—Same. Male (pale blue) trophozoite nearly filling a blood corpuscle; with pigment spots. Freehand sketch. Dimensions of parasite 13 microns by 10 microns.

Fig. 13.—Same. Male trophozoite rounded.

Fig. 14.—Same. Female (dark blue) trophozoite with pigment and several vacuoles.

Fig. 15.—Same. Female trophozoite rounded.

Fig. 16.—Same. Double infection of a blood corpuscle with two male (pale blue) trophozoites. The corpuscle is deeply constricted.

Fig. 17.—*Hæmogregarina nicoriæ.* Young trophozoite with refringent granules, near to the nucleus of a corpuscle. The outline of the corpuscle is omitted. Fresh preparation.

Fig. 18.—Same. Trophozoite in corpuscle. Fresh preparation. The spots are chromatoid granules, not pigment, in this and following figures.

Fig. 19.—Same. Trophozoite bending up. From a stained preparation.

Fig 20.—Same. Trophozoite doubled upon itself.

Fig. 21.—Same. Double infection of a corpuscle.

Fig. 22.—Same. The nucleus of the trophozoite is divided into four.

Fig. 23.—Same. A trophozoite unrolled within a corpuscle.

Figs. 24, 25, and 26.—Same. Sketches of a parasite free in the plasma, illustrating the movements observed.

Fig. 27.—Same. Another position of the same free individual.

Figs. 28–38 relate to *Hæmogregarina mirabilis.*

Fig. 28.—Trophozoite bent double; from a preparation of the endoglobular infection.

Figs. 29—30.—From the free infection.

Fig. 29.—Monozoite forming within the cytocyst.

Fig. 30.—Fully formed monozoite inside a cytocyst within the blood corpuscle.

Fig. 31.—Monozoite commencing to issue from the cytocyst.

Fig. 32.—Monozoite half way out of the cytocyst and corpuscle.

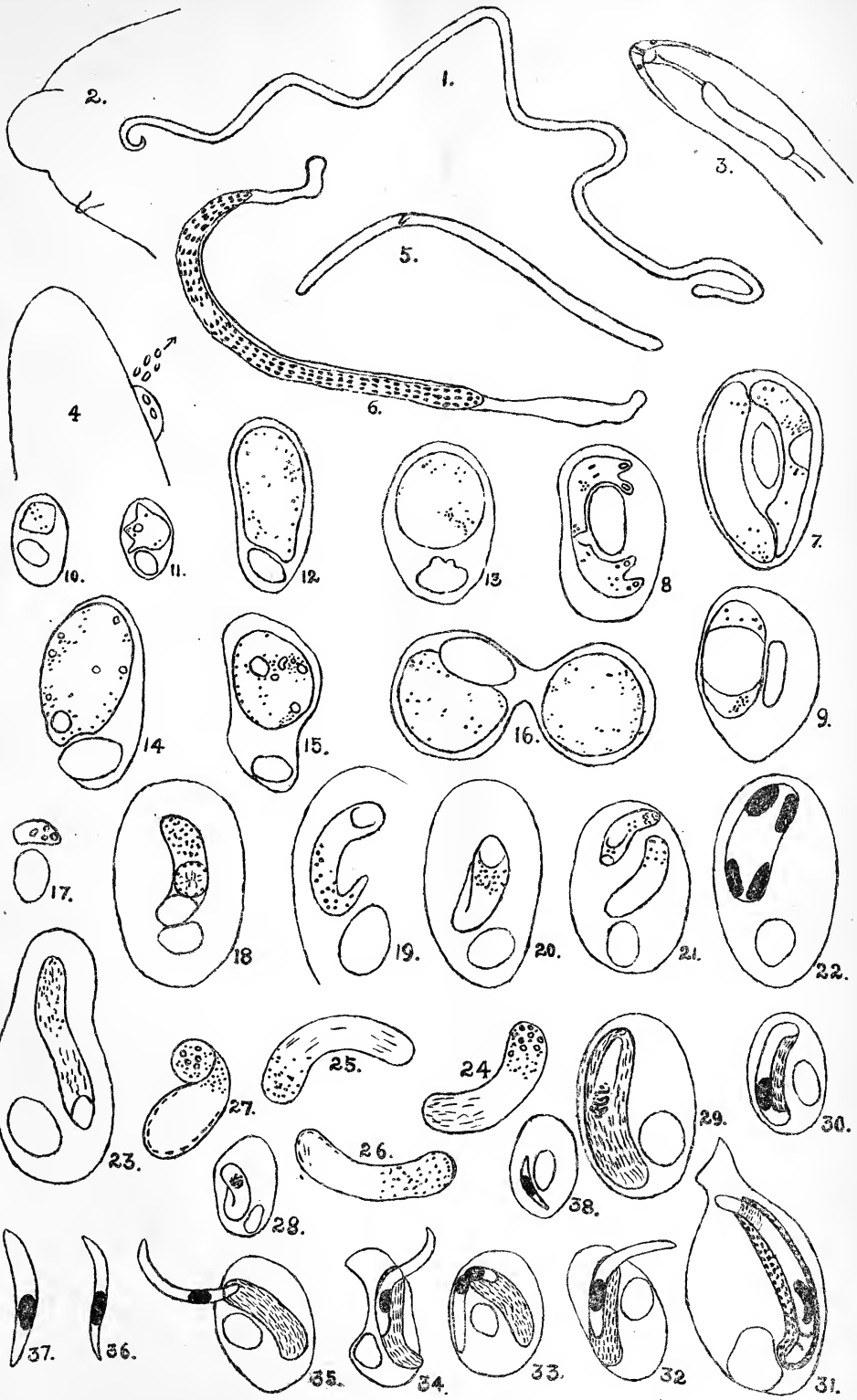
Fig. 33.—Monozoite leaving the cytocyst, but remaining within the corpuscle.

Fig. 34.—Another emerging monozoite.

Fig. 35.—Monozoite nearly free from cytocyst and corpuscle.

Figs. 36 and 37.—Two free monozoites. Oc. 4. Obj. $\frac{1}{12}$ cam. luc.

Fig. 38.—Dwarf monozoite within a corpuscle.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HAEMATOZOA

NOTE.

The Black Variety of Felis chaus.—On the 16th February this year a Sinhalese man belonging to the Yatiyantota district, who collects specimens for me, brought in what appeared at first sight to be a domesticated cat of a pure black colour; but the man vigorously protested that not only was this a jungle cat, but other cats of the same colour had been seen before, and it was known that there was a black jungle cat. Upon closer examination I saw at once that it differed from an ordinary house cat, while I found that it resembled the jungle cat (*Felis chaus*) in the following important points:—(1) Pupil round; (2) ears long, with a small tuft of longish hairs inside the ear, about half way down; (3) tail short; (4) skull broad; (5) the wavy lines noticeable on the sides of some specimens of *Felis chaus* being just traceable.

On looking up *Felis chaus* in "Blanford's Mammalia" Faun. Br. Ind. pp. 86, 87, I found that a black variety had been sometimes found in India, so I lost no time in curing the skin, which as soon as it was ready I sent down with the skull to the Colombo Museum to Dr. Willey, who very kindly examined it and replied as follows:—

"There seems no doubt that it is a black specimen (melanic variety) of *Felis chaus* ..... The ear tufts seem to have been lost, but the length of the ears and the characters of skull and teeth stamp it as *F. chaus*. I suppose there is no doubt of its having been genuinely wild here, *i.e.*, it is presumably not an escapee."

The cat had been trapped and had not been long dead when it was brought to me. Its captor informed me that on the previous morning he found a jungle cock caught in a trap which had been set for mouse deer (*Tragulus meminna*). The fowl had been half devoured by some animal; so, suspecting a cat, he reset the trap using the remains of the jungle fowl as the bait. The statements of the Sinhalese man about there being a black jungle cat cannot be relied on, but there is not the slightest chance of the animal having been imported here, nor is there any doubt as to its having been born in Ceylon; but there remains the chance of its being the result of a cross between a domesticated

cat and *Felis chaus*. I have tried to find out if there are any black cats in the district, but cannot hear of any; in fact, the villagers here are very poor, and I do not think it is all likely that many, if any cats at all, are kept by them.

Then again, I think it may be reasonably presumed that the result of a cross would not have been so completely of the character of *Felis chaus*, but would have shown some point to prove its real identity.

Apart from these remarks Dr. Willey's statements are sufficient to allow the black variety of *Felis chaus* to be counted among the mammals of Ceylon.

H. M. DRUMMOND-HAY.

Punagalla,
Yatiyantota, May 22, 1904.

SPOLIA ZEYLANICA.

ISSUED BY

THE COLOMBO MUSEUM,

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VOL. II.—PART VII. OCTOBER, 1904.

CONTENTS.

With five Plates.

COLOMBO:
GEORGE J. A. SKEEN, GOVERNMENT PRINTER, CEYLON.

1904.

DESCRIPTION OF A NEW SNAKE.

By G. A. Boulenger, F.R.S., V.P.Z.S.

With Plate.

Aspidura drummondhayi.

Rostral very small, as deep as broad, just visible from above; internasal as long as the suture between the præfrontals; frontal hexagonal, as long as or a little longer than its distance from the end of the snout, about two-thirds the length of the parietals, its greatest width, at the posterior borders of the supraoculars, nearly twice its anterior width; supraocular more than twice as long as broad, more than half the length of the frontal: præfrontals in contact with the eye and with the second, third, and fourth upper labials; no præocular; two postoculars, lower larger; temporals 1 + 2; six upper labials, first and second very small, sixth largest, fourth entering the eye; four lower labials in contact with the anterior chin-shields, which are much longer than the posterior. Scales in 15 rows, feebly keeled near the vent. Ventrals 112 (♂) to 135 (♀); anal entire; subcaudals 18 (♀) to 26 (♂), all or greater part in two rows. Dark purplish brown above and below, strongly iridescent, with minute whitish dots or vermiculations; five rather indistinct blackish streaks and the outer corresponding to the angle of the mouth.

Total length 220 millim.; tail 22.

This very distinct new species is described from two specimens, male and female, presented to the British Museum by Mr. H. M. Drummond-Hay, by whom they had been referred to the correct genus. The paired condition of the caudal shields in this species will necessitate an alteration to the definition of *Aspidura*, the previously known species having single subcaudals. I cannot regard this difference as generic, especially in view of the fact that the four anterior shields of the male specimen here described are single.

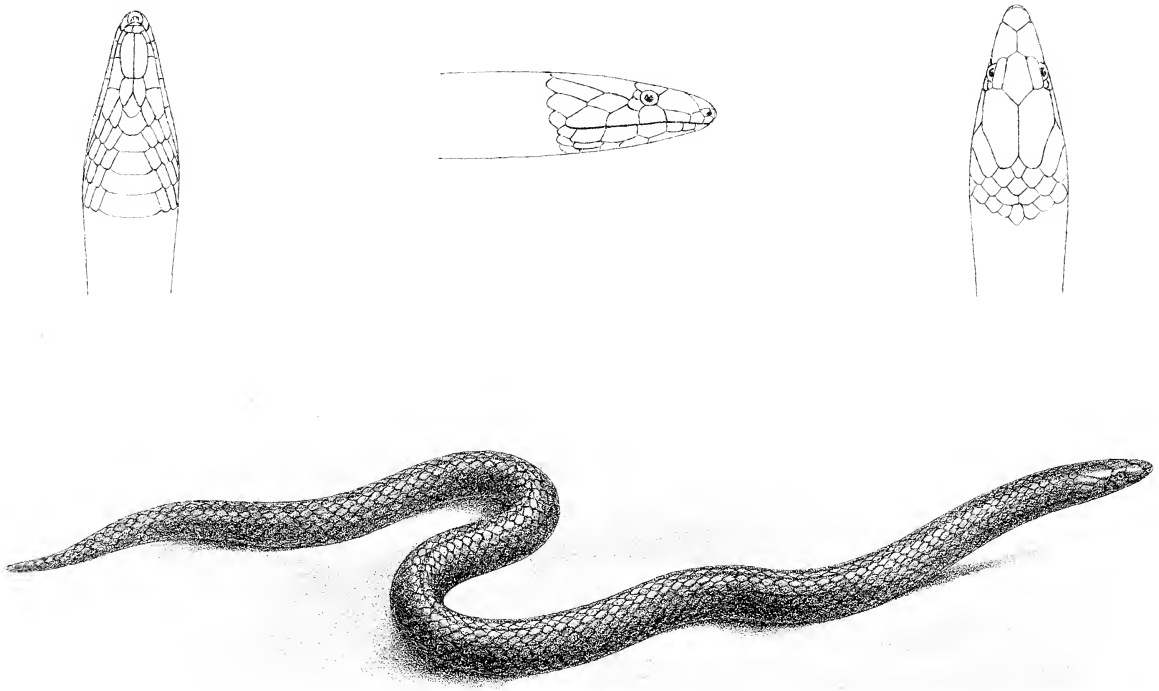
Several specimens were found on the Hopewell estate, Balangoda, by Mr. H. M. Drummond-Hay during March, April, and May, 1903, while clearing out drains in a field at the very top of

the estate, the probable elevation being from 3,500 to 4,200 feet above sea level. The specimens are evidently about full-grown, and the species is viviparous, as embryos have been found in a specimen of no larger size. From the same field during the same period Mr. Drummond-Hay obtained *Rhinophis blythii* and *Haplocercus ceylonensis* in great abundance, and four specimens of *Aspidura copii*.

EXPLANATION OF THE PLATE.

Aspidura drummondhayi, natural size, with enlarged figures of upper, lower, and side views of head.

Spolia Zeylanica.



J.Green del.et lith.

ASPIDURA DRUMMONDHAYI.

Mintern Bros. imp.

THE TETTIGIDÆ OF CEYLON.

By Dr. Joseph Lane Hancock,
(Chicago.)

With three Plates and a Map.

Introduction.

IT is the aim of the present Paper to enlarge and systematize our knowledge of the Ceylonese forms of that important group of Orthoptera known as the Tettigidæ,* and to furnish a basis for their future study. Some of the species of the Island noted by various writers, the descriptions of which are scattered through several scientific publications, have been brought together, and for the most part redescribed in detail. Six new genera and about nine new species are described here for the first time. Altogether sixteen genera and approximately twenty-seven species including varieties are treated. At present no others are known in Ceylon.

Obscure forms of Orthoptera, such as the Tettigids, have rarely been thoroughly collected in any tropical island, and for this reason peculiar interest attaches to the present study.

Ceylon from a General Viewpoint.

Ceylon is two hundred and sixty-six miles from Point Pedro, the northerly extremity to Dondra Head at the extreme southern point of the Island. It is one hundred and forty and a half miles in breadth at the widest part from Colombo on the west, to Sangemanhand on the eastern coast, and comprises an area of twenty-four thousand seven hundred miles. (Ceylon, 1876, p. 13.) One may well conceive the richness of the flora of the Island on referring to the photographic plates in Emil Schmidt's travels (1897) depicting the landscape of the country. Here are disclosed the wild tangle of vegetation, with the winding streams here and there skirted by tropical forests. In this volume and in the pages of Cave's work (1901) we find pictured the paradise of animal life. In the jungle or among the dead leaves in the shade of the forests, in the grassy fields, or by the margins of the rivers, the ponds, and

* The term *Acrydiidæ* of late has been substituted for the term *Tettigidæ* by some entomologists, notably Kirby (1902), much to the confusion of nomenclature.

mountain streams where the mosses cover the wet rocks, it requires but little imagination to conceive the ecological relations of the little orthoptera whose forms, amid such surroundings, have taken on such great differences in structure. Before the cultivation of this Island proceeds too far, with the incidental extermination of animal life by man, it is hoped that the fauna will be carefully studied, with a view of throwing much-needed light on the evolution of insular faunæ.

The accompanying map of Ceylon (plate IV.) compiled from several reliable sources shows where the collection of Tettigidæ was made.*

Characteristics of the Tettigidæ.

Members of this group of Acridians are quite easily distinguished by their small size, some of the species being the smallest representatives of the Acridiidæ. The large pronotum, covering the body, is moreover a marked characteristic and not infrequently it is prolonged backward to the end of the abdomen or the tips of the hind femora or even beyond. The tegmina or elytra are very small and rudimentary, being represented by small lobes or scales placed at the sides of the body, occupying the posterior elytral sinus, and covering only a very small portion of the base of the wings. The wings are usually well developed, and are remarkable for the narrowing of the wing proper, or the part before the anal furrow, the hind part or anal area being enormously developed. Both elytra and wings are sometimes absent. The venation of the wings is the most specialized of that of any of the orthoptera. The prosternum is extended forward in a sternomentum or chin-piece which surrounds the mouth parts. No arolium is present between the terminal claws of the tarsi. Viewed in profile the subgenital plate of the male is conical or triangular; the valves of the ovipositor are serrulate, having their extremities divergent. In this connection it may be well to draw attention to a few of the characters of most practical use in diagnosing the species, namely, the proportions of the eyes, vertex, facial frontal costa, the pronotum with its related parts (the lateral lobes), the femora, and the relative length of the posterior tarsal articles. The character of the antennæ, the nature of their insertion, and the position of the posterior ocelli, in conjunction

* One point known as Haragama could not be located. The three places—Kadugannawa, Peradeniya, and Kandy—are sixty-five, seventy-one, and seventy-five miles inland, respectively, from Colombo, which is on the western coast. Hantanne or Hantane is on a rugged cliff rising to the height of four thousand one hundred and nineteen feet, and is the highest point in the tea-growing district. It can be seen from Kandy looking across the lake.—(Cave, 1901.)

[Haragam is about eight miles from Kandy.]

with the aforesaid characters, are used in distinguishing the groups.

The infra-scapular area sometimes referred to in the descriptions lies just below the shoulders on each side of the pronotum immediately above the elytra (when the latter are present) and usually is bounded posteriorly by the small curved humero-apical carina, but sometimes it is prolonged distad. Just above this infra-scapular area at the outer side of the shoulders, on the dorsum, is sometimes a narrow linear or triangular area separated by the prolongation forward of the latero-apical carina. This was termed the scapular area by Morse (1900, p. 4). In some species the infra-scapular area is represented by a widened prolonged area lying below the lateral carina forming a broad margin. This often appears in the Cladonotinæ. In some extreme cases the scapular and infra-scapular areas may even be very narrow, being then about the same width opposite the outer half of the elytra as instanced in Scelimena, the shoulder then appearing bicarinate.

The posterior ocelli are variously situated with relation to the eyes. Those genera in which species are represented with their position nearly on a plane with the middle of the eyes are, namely, *Cladonotus*, *Deltonotus*, *Loxilobus*, *Criotettix*, *Apterotettix*, *Tettix*, *Euparatettix*, *Hedotettix*, *Coptotettix*, *Acanthalobus*, and *Paratettix*. In *Mazarredia* and *Lamellitettix* they are situated on a plane with about the lower third of the eyes; while in *Scelimena*, *Gavialidium*, and *Systolederus*, they are almost on a plane with the lower margin of the eyes.

Some Minor Changes in Classification.

In the study of the various species of the genus *Criotettix*, it was found that some of the characters which had already been noted by Bolivar (1887, p. 223) in his table were of sufficient difference to separate the species possessing them into new genera. For example the group of which *C. tricarinatus*, Bol., forms the type does not conform to the group of which the very distinct *C. miliarius*, Bol., is a representative. At the same time there are distinctions to be found dividing the above two representative groups from the new species *Loxilobus acutus*, which forms the third generic type. The three genera thus formed may be summarized as follows :—

First Division.—In the *tricarinatus* group (plate III., figs. 15–15*b*) the head and eyes are lightly elevated, or exserted, the vertex being distinctly narrower than one of the eyes, or subequal, the spine of the lateral lobe of pronotum being distinct, and transverse or bent obliquely forward. This characterizes the genus *Criotettix*, Bol.

Second Division.—In the *miliarius* group (plate I. figs. 8–8*a*) the stature is larger, the antennæ shorter, the head and eyes not at all elevated, the spine of the lateral lobes distinctly obliquely directed backward. Genus *Acanthalobus*, Hanc.

Third Division.—On the other hand, in *L. acutus* group (plate I., fig. 3, and plate III., figs. 16–16*b*) the body is moderately small, the facial frontal costa roundly produced before the eyes, the posterior angle of the lateral lobes only a little acute produced or obliquely excised. Genus *Loxilobus*, Hanc.

There is some doubt as to whether the latter genus should not be placed in the section *Metrodorinæ* instead of the *Scelimeninæ*. It became necessary also to create a new genus to include *Paratettix personatus*, Bol., together with another new species under the name *Euparatettix*.

Extremes of Structural Modifications.

This group presents an interesting array of remarkable species, some of which are grotesque in the form of the body. The individual variations, the gradation of forms, the slight differences sometimes existing between the groups, the change of form incident to isolation on the one side, and wide distribution on the other, offer exceedingly difficult obstacles in the way of systematic arrangement. This difficulty is relieved in a measure by the accompanying drawings which help to elucidate the descriptions. The diversified forms of body development suggest intense struggle for existence, and among them, moreover, is admirably exhibited an exquisite adaptation, especially in the direction of protective resemblance. In the instance *Scelimena gavialis*, De Sauss., the combination of vivid red and dark fuscous is exceptional among the Tettigidæ. The richness of genera contrasts quite markedly with the comparative paucity of forms found in more temperate regions of the world. A contrast also will be discovered in comparing the highly specialized tropical forms with the simple types observed in northerly latitudes.

Habits in General.

The habits of some of the species are correspondingly singular in some respects, as might be inferred from the anatomical structures; notably the remarkable species *Gavialidium crocodilus* shown in plate II., fig. 11, with its flattened prolongate body. It closely imitates the rough sculpturing of excoriate moss-covered rocks over which water constantly trickles. The insect is so secure in its resemblance to the rocks and is made so confident by its adaptation that it acts very sluggish, seldom taking to its wings. According to observations of Mr. E. Ernest Green (1902,

p. 214) on the aquatic habits of *Scelimena gavialis*, Sauss. (Plate I., fig. 4), there is in Ceylon "a large group of aquatic Acridians of the family Tettigidæ, *e.g.*, *Scelimena* (*harpago*) *gavialis* Sauss., and allied species. This species in particular has the hind tibia and tarsus laterally expanded for swimming. The insects frequent the mountain streams of Ceylon, resting on the wet rocks in mid stream. When disturbed they leap without hesitation into the water, and either swim to another rock or dive to the bottom, often remaining there for a considerable period." The author then states that he remembers "on one occasion observing the larva of a *Tettix* walking about among the dead leaves at the bottom of a shallow pool." Lastly he states that *Gavialidium crocodilus*, De Sauss., is another species that frequents wet rocks; though he has never seen this insect actually take to the water. According to Bolivar (1887) Capt. Boys and Westwood have recorded similar amphibious habits in *Scelimena*, and similarly Sharp (1895) reiterates observations, probably by these authors, on the Ceylon and Himalayan species. De Saussure (1860, p. 481) likewise narrates the following observations made by M. A. Humbert, who was then keeper of the Museum of Geneva:—

"The species of Scelimena live upon the borders of rivulets and ponds. They post themselves upon the rocks and frequently dart out upon the water leaping and fluttering by means of their large membranous wings. They poise on the water without becoming wet, and then in clearing the surface use their wings again.

"This ability of taking the water as a point of departure undoubtedly is due to the dilatation of the first joint of the posterior tarsi which has been observed among these species. These insects appear moreover to have no fear of immersing themselves completely. They jump into the water as well as upon the surface, and it is probable that their posterior tibiæ, membranous at the borders, and the first joint of the posterior tarsi, when it is enlarged, perform the function of fins. Finally the species of *Scelimena* also like to refresh themselves in the tiny streams of water which glide along the rocks. One often finds them firmly clinging to a rock and entirely submerged by the current of water, apparently taking a bath. These habits have been observed equally in both *Scelimena crocodilus* and *Scelimena gavialis*."

An allied competitor in the racial struggle, *Scelimena logani* (plate I., fig. 5), probably displays similar or even more pronounced amphibious tendencies, as evidenced in the very widely laminate expanded margins of the posterior tibiæ, which are formed into perfect paddles for swimming. It was found frequenting a rocky stream and also living on rocks and in the water

of the Mahaweli-ganga (river.) This species does not have the body margined with red as in the preceding. The crested *Deltonotus tectiformis* (plate I., fig. 2) differs in its habits materially from those above described in that it lives on the ground among fallen leaves in the jungle under shade trees. The body of this insect is shaped somewhat like a beech nut, being compresso-cristate and gently arched above from before backward. One of the unique species is the interesting horned *Cladonotus latiramus* figured on plate I. fig. 1, the only specimen of which was discovered on a bungalow wall. Its body is provided with many spiniform tubercles, and the pronotum is elevated forward into a vertical ramus. The very rough-backed *Lamellitettix acutus* (plate II., fig. 6), with its lateral lobes of the pronotum outwardly projecting in the form of broad-based spines, is represented by one female specimen taken from the stem of a tree in a thick jungle. Contrasting with the foregoing is the graceful bodied *Criotettix tricarinatus* (plate III., fig. 15) with delicate spines arming the lateral lobes. It seems to be one of the commonest species locally, appearing in considerable numbers on the margin of a river, the side of a railroad bank and on grass lands. A nearly allied species, *Criotettix spinilobus* (plate III., fig. 12), was found on swampy ground. The rather large *Acanthalobus miliarius* (plate II., fig. 8) was found frequenting rice fields, the dry bed of a tank, and the banks of a stream. The long-wing somewhat slender-bodied *Loxilobus acutus* (plate I., fig. 3) was caught at light. Another smaller species *Loxilobus rugosus* (plate III., fig. 16) inhabits swampy ground and grass lands. Of bizarre forms *Systolederus greeni* (plate II., fig. 9) is an excellent example. The large globose eyes drawn very close together present a most peculiar aspect, being compressed and elevated considerably above the somewhat flattened dorsum. It lives on hot dry rocks away from water and is very active on the wing. The small-bodied *Mazarredia insularis* (plate II., fig. 7) is often coloured like the natural lichens and mosses among which it lives and is very inconspicuous. The small apterous species *Apterotettix obtusus* (plate III., fig. 13) has a very short pronotum and angulate head. It lives among fallen leaves under shade trees, having similar habits in this respect to *Deltonotus tectiformis* previously referred to. It is also found in grassy fields. The long-wing *Tettix atypicalis* (plate III., fig. 14) lives on grassy land. The short-wing form, *Tettix a. ceylonus*, lives in similar situations. *Euparatettix personatus* (plate II., fig. 10) abounds in the rice fields. The beautiful *Hedotettix attenuatus* (plate III., fig. 18) is remarkably variable in colour, often having a light longitudinal

stripe extending the whole length of the middle of the dorsum. Like several other species it occurs in the rice fields.

It is quite likely that the habits of oviposition in the Ceylonese Tettigidæ are similar to if not identical with those of the same group of these Acridians found in North America which are treated at some length in my recent monograph (1902). In brief, the female makes a burrow in the ground with her ovipositor from five to ten millimeters deep. At the bottom of this hole she lays her eggs one by one, side by side, fastening them together as fast as laid with a glutinous secretion from the vagina. The mass finally consists of a variable number of eggs, the whole being shaped like a pear, the attenuated extremity of each egg being directed upwards. In selecting a site to deposit the eggs, *Tettix* choses vegetable mould or, more frequently still, a spot covered with lichens or moss. After oviposition the hole is neatly covered with fine particles of soil or vegetation, which the female scrapes up by the skillful use of the hind tarsus in some species, or by the ovipositor in others.

Apterous Species and Dimorphism.

Four apterous species of Tettigidæ are here recorded from Ceylon : namely, *Cladonotus humbertianus*, *Cladonotus latiramus* (plate I., fig. 1), *Deltonotus tectiformis* (plate I., fig. 2), and *Apterotettix obtusus* (plate III., fig. 13). The majority of the species possess fully-developed wings which give them excellent power of flight. The large number of specimens of long-wing forms caught at light in different localities suggest that these forms are capable of migration. Among the species represented as being caught at light and which doubtless participate in local flights or migrations are : *Acanthalobus miliarius*, Bol., *Loxilobus acutus*, Hanc., *Euparatettix personatus*, Bol., *Hedotettix gracilis*, De Hann., *Tettix atypicalis*, Hanc. A number of the species are dimorphic in the length of the wings and pronotum.

Quantitative Variations.

An insufficient number of specimens prevented extensive studies of the species in most cases from the quantitative point of view. Yet, in the instance of *Hedotettix*, even the small series of measurements proved of value in leading to the supposition that the species that is nominally given here as *attenuatus* is a recently derived species, in that stage of evolution where some individuals present gradations connecting it with *gracilis*. In making the measurements of the insects the "length of body" refers to the total distance between the front of the head and the apex of the wings or pronotum. Some authors give the length of body as the

distance between the front of head and apex of the abdominal appendages. This is unreliable owing to shrinkage of the body. Taking the pronotal measurements, for example, as represented in the three series given in the sequence, the short-wing *gracilis*, the long-wing *gracilis*, and long-wing *attenuatus*, place modes, the result of geographical segregation, are detected and sufficiently well marked in degree of divergence and of isolation to distinguish the species, though strictly speaking, they are not severed entirely.

The Origin of Denticles and Spines.

That some of the spines and denticles on the Tettigid body have originated at different periods in the evolution of the species is indicated by the following observations:—Six nymphs of *Criotettix tricarinatus*, Bol., from seven to seven and a half millimeters in length, and having the pronotum extended backwards nearly to the knees of the posterior femora, not only differ from the adult in the size of the body, but especially in the character of the lateral lobes of the pronotum. In these nymphs which are presumably in the stage before the last moult, the lateral lobes are slightly laminate, but scarcely at all or very slightly acute produced outwards, and are obliquely truncate behind. From this it is inferred that the rather long spines arming the lateral lobes in the adult do not appear until after the last ecdysis, at which time the pronotal apex and wings, including the elytra, coincidently attain their full development. That these spines of the lateral lobes are of recent origin is shown by their variable form in the adult, together with their absence or vestigial character in the later nymph stage as before intimated. A study of the denticles on the lower margins of the femora in *Scelimena logani*, Hanc., on the other hand, leads me to think that these structures must date back to a much more remote period, for they are present in a well-developed condition in the nymphs of that species.

Faunal Resemblances.

Among other known facts accentuated by the present study is the close similarity existing between the faunæ of Ceylon, Oriental India, Burma, the Philippines, and Java. It will suffice here to refer only to one noteworthy species, *Hedotettix gracilis*, De Hann., which ranges over the localities named. Fully as important is the fact that certain genera and species as discussed in the sequence are confined to the Island of Ceylon. Wallace (1895) describes the "Oriental region" as comprising all Asia, south of the Palæarctic limits, and along with this the Malay Islands as far as the Philippines, Borneo, and Java. It was called the Indian region by Sclater. Before this Wallace (1876, pp. 326-327), saw the

necessity of subdividing that part of the Oriental region, including Ceylon as a "Ceylonese" province which is set forth in the following quotation: "The Island of Ceylon is characterized by such striking peculiarities in its animal productions as to render necessary its separation from the peninsula of India as a sub-region; but it is found that most of these special features extend to the Neilgherries and the whole southern mountainous portions of India, and that the two must be united in any zoo-geographical province. The main features of this subdivision are the appearance of numerous animals allied to forms only found again in the Himalaya or in the Malayan sub-region, the possession of several peculiar generic types, and an unusual number of peculiar species."

It will be seen that my observations given above and those further on relating to the geographical distribution of the Tettigidæ have a significant bearing in supporting both of these claims made by Wallace.

Geographical Distribution.

The Tettigidæ are by no means confined to any single portion of the world, but are widely distributed. In Ceylon we infer these insects are quite generally distributed, and some of the genera occurring here have quite an extensive range passing the borders into other countries as before intimated, while again some genera are confined to the island. So far as our present knowledge indicates the genera *Deltonotus*, *Lamellitettix*, and *Apterotettix* are of this latter class, all being represented by single monotypic species found in the Central Province. The genus *Cladonotus* ranges to Japan, the Philippines, New Guinea or Papua, and within Ceylon two species occur in the Central and Eastern Provinces. *Scelimena* presents two species from the Central Province, and like the preceding genus passes the borders of the island into Java, Burma, and British India. With respect to *Gavialidium* two species are found here in the Central Province. The range of distribution of the genus extends to Celebes, the Philippines, Burma, and New Guinea. A number of species have been included by authors in the genus *Criotettix* which, in all probability, do not belong there. For this reason the species appear to be unusually numerous. The genus is here represented by only two species. They are both found in the Central Province, while outside of Ceylon, according to data at hand, it extends to Sumatra, Celebes, New Guinea, Lower Burma, and Southern India. The genus *Acanthalobus*, with its two species, occurs in the Central and Western Province, in the region about Colombo. *Loxilobus*, with its two species is found in the Central Province, and may be

confined to the island. There are only two forms of Ceylonese *Tettix* also found in the Central Province, although the range of the genus is of very wide dispersal from such widely separated places as Australia, Java, the Philippines, America, Europe, Africa. *Systolederus* has but one species here, but the genus is distributed in the Philippines, Celebes, Southern India, and Burma. Two species of *Euparatettix* are found in the Northern Province at Elephant Pass and Jaffna, as shown on the map, being also noted in the Central and Western Provinces. The genus extends to other Oriental points, such as Burma, Java, and the Philippines. *Paratettix* is known by one species in the Island. *Hedotettix* follows with three representatives from the Western and Central Provinces, but the genus has an extensive range outside the Island, having been recorded from Java, China, Philippines, Sumatra, and even Africa. Of two species of *Coptotettix* recorded from Ceylon there is no record of their local distribution. The genus extends to Java, Australia, Africa, China, and the Philippines.

It may be well here to suggest that the cause of the restriction of these insects to limited areas lies in the fact of their extreme specialization. Those forms in which the power of flight is well developed and which are aided by the wind factor in their dispersal, and are thereby carried greater or lesser distances, might easily survive in a new country under favourable conditions. They usually have a slender or prolongate body, and they live in the more open country. Some of the forms are evidently of great antiquity while others are recent. The process of appreciable divergence and formation of species is perceivable in some cases and capable of demonstration, both by measurements and in the appearance of subtile differences among individuals and groups of individuals that the experienced eye can detect. The height of one phase of specialization is reached in forms which resemble the dead twigs or leaves among which they live. The insects simulate these objects in shape, colour, and in the case of the leaf resemblance even copying to a certain degree the veins or ribs. This venation appears on the sides of the compressed pronotum. With our limited knowledge of the group the provisional inference reached is that the highly specialized genera like the apterous *Deltonotus* living on the bed of the forest among the dead leaves in the mountainous region has been isolated from a remote period.

Acknowledgments.

The present study is the outcome of the very generous action of Mr. E. Ernest Green, Entomologist on His Majesty's service in Ceylon, in placing in my hands a collection of specimens which

he obtained principally during the season of 1903. In accordance with this plan the carefully preserved material comprising about two hundred specimens was received in good condition and formed the basis of this monograph. Not only is the author indebted to Mr. Green for the collection, but also for notes concerning the *habitat* of many of the species which he furnished on request. Recourse was had to a small number of specimens previously contributed to my collection by Prof. Ignacio Bolivar of Spain and Mr. Malcolm Burr of England, to whom acknowledgment is here again tendered.

The admirable work of Bolivar (1887) forms the foundation of our systematic knowledge of the Tettigidæ. This "Essay" embraced, among other valuable facts, a table of the classified grouping of sections and genera which the student of orthoptera will find indispensable. In the interval or since the above-mentioned work appeared, many interesting new species and genera have been described in various publications. There is need, therefore, of a complete revision, one that will not only bring together the forms existing in the world, but moreover meet the requirements and be treated from the recent biological aspect of the subject.*

Enumeration of Genera and Species.

Subtribe I.—*CLADONOTINÆ.*

Genus *Deltonotus*, Hanc.

1. Deltonotus tectiformis, Hanc. (Plate I., figs. 2-2*a*.)

Genus *Cladonotus*, De Sauss.

2. Cladonotus humbertianus, De Sauss.
3. Cladonotus latiramus, Hanc. (Plate I., figs. 1–1*a*.)

Subtribe II.—*SCELIMENINÆ.*

Genus *Scelimena*, Serv.

4. Scelimena gavialis, De Sauss. (Plate I., figs. 4–4*c*.)
5. Scelimena logani, Hanc. (Plate I., figs. 5–5*c*.)

Genus *Gavialidium*, De Sauss.

6. Gavialidium crocodilus, De Sauss. (Plate II., figs. 11–11*b*.)
7. Gavialidium alligator, De Sauss.

Genus *Lamellitettix*, Hanc.

8. Lamellitettix acutus, Hanc. (Plate II., figs. 6–6*b*.)

* Such a revision is contemplated by the present author if sufficient material can be obtained to warrant the undertaking. For the contribution of specimens from any part of the world the author will be most profoundly grateful. Acknowledgment will be given in the work to those who thus extend their aid.

Genus *Criotettix*, Bol.

9. Criotettix tricarinatus, Bol. (Plate III., figs. 15–15*b*.)
10. Criotettix spinilobus, Hanc. (Plate III., figs. 12–12*b*.)

Genus *Acanthalobus*, Hanc.

11. Acanthalobus miliarius, Bol. (Plate I., figs. 8–8*a*.)
12. Acanthalobus cuneatus, Hanc.

Genus *Loxilobus*, Hanc.

13. Loxilobus acutus, Hanc. (Plate I., fig. 3, and Plate III., figs. 16–16*b*.)
14. Loxilobus rugosus, Hanc. (Plate II., figs. 17–17*b*.)

Subtribe III.—*METRODORINÆ*.

Genus *Systolederus*, Bol.

15. Systolederus greeni, Bol. (Plate II., figs. 9–9*b*.)

Genus *Mazarredia*, Bol.

16. Mazarredia insularis, Bol. (Plate II., figs. 7–7*b*.)

Genus *Apterotettix*, Hanc.

17. Apterotettix obtusus. (Plate III., figs. 13–13*a*.)

Subtribe IV.—*TETTIGINÆ*.

Genus *Tettix*, Charp.

18. Tettix atypicalis, Hanc. (Plate III., figs. 14–14*b*.)
19. Tettix atypicalis ceylonus, Hanc.

Genus *Paratettix*, Bol.

20. Paratettix variegatus, Bol.

Genus *Euparatettix*, Hanc.

21. Euparatettix parvus, Hanc.
22. Euparatettix personatus, Bol. (Plate II., figs. 10–10*b*, and Plate III., figs. 20–20*b*.)

Genus *Hedotettix*, Bol.

23. Hedotettix gracilis, De Hann. (Plate III., figs. 19–19*b*.)
24. Hedotettix gracilis abortus, Hanc.
25. Hedotettix attenuatus, Hanc. (Plate III., figs. 18–18*b*.)

Genus *Coptotettix*, Bol.

26. Coptotettix fossulatus, Bol.
27. Coptotettix testaceus, Bol.

KEY TO TRIBES AND GENERA.

A.—Facial costa widely forked forming a frontal scutellum.

1.—Subtribe *CLADONOTINÆ*.

B.—Pronotum transversely acute tectiform, viewed in profile dorsal margin of crest gently arcuate (Plate I., figs. 2–2*a*.)

Deltonotus gen. nov. (p. 111)

B.B.—Pronotum presenting a distinct ramose process; body provided with spiniform tubercles. (Plate I., figs. 1–1*a*.)

Gen. *Cladonotus*, Sauss. (p. 112)

A.A.—Facial costa with the rami but little or moderately divergent or parallel or narrowly sulcate.

C.—Pronotum truncate in front, posterior angles of lateral lobes more or less laminato-produced outwards, armed with a spine or acute produced (with single exception I.).

D.—Posterior angles of lateral lobes of pronotum outwardly acute produced, or armed with a spine; posterior tibiæ strongly ampliate toward the apex, or when not dilated the margins spinose (with single exception G).

II.—Subtribe *SCELIMININÆ*.

E.—Posterior tibial margins strongly expanded, first articles of posterior tarsi laterally dilated, much wider than the third articles. (Plate I., figs. 5–5*c*). Habits amphibious.

Gen. *Scelimena*, Serv. (p. 116)

E.E.—Posterior tibial margins slightly or moderately expanded.

F.—Vertex with the anterior carinulæl aterally compresso-cutee.

G.—Pronotum distinctly flattened above, very rugose, marked by numerous more or less distinct fossæ or reticulations; lateral margins of posterior tibiæ minutely serrulate, unarmed. (Plate II., figs. 11–11*b*.)

Gen. *Gavialidium*. De Sauss. (p. 122)

G.G.—Pronotum between the shoulders trigibbo-cristulate; body smaller, lateral lobes of pronotum outwardly strongly triangularly acute produced, spiniform; antennæ unusually long and slender, articles distinctly elongate. (Plate II., figs. 6–6*b*.)

Lamellitettix, gen. nov. (p. 125)

F.F.—Vertex with the frontal carinulæ laterally not at all compresso-acute.

H.—Body rather slender; vertex distinctly narrower than one of the eyes or subequal; eyes very lightly elevated exserted; spine of lateral lobe distinct, directed subtransversely or bent obliquely forward. (Plate III., figs. 15–15*b*.)

Gen. *Criotettix*, Bol. (p. 128)

H.H.—Stature moderately robust; dorsum of pronotum rugose or rugulose; eyes not at all elevated; antennæ shorter; spine of lateral lobes distinctly obliquely directed backwards. (Plate II., figs. 8–8*a*.)

Acanthalobus, gen. nov. (p. 131)

I.—Facial frontal costa roundly produced before the eyes ; lateral lobes of pronotum slightly acute subspiniform produced, or obliquely obtuse. (Plate I., fig. 3.)

Loxilobus, gen. nov. (p. 134)

D.D.—Posterior angle of lateral lobes of pronotum outwardly little produced, obliquely truncate behind, or, if not so, the angle deflexed downward ; first and third articles of posterior tarsi subequal in length.

III.—Subtribe *METRODORINÆ.*

J.—Head distinctly compresso-elevated, vertex strongly narrower than one of the eyes ; posterior ocelli situated on a plane nearly with the lower border of the eyes. (Plate II., figs. 9–9*b*.)

Gen. *Systolederus*, Bol. (p. 136)

J.J.—Head not compresso-elevated ; posterior angles of the lateral lobes of pronotum distinctly truncate behind.

K.—Body with elytra and wings absent.

L.—Facial frontal costa distinctly produced before the eyes ; vertex in profile obtuse angulate ; pronotum granulate rugulose ; wings and elytra absent or barely vestigial. Plate III., figs. 13–13*a*.)

Apterotettix, gen. nov. (p. 140)

K.K.—Body provided with elytra and wings.

M.—Median carina of pronotum undulate subserrulate ; vertex with the anterior carinulæ laterally compresso-acute, little elevated. (Plate II., figs. 7–7*b*.)

Gen. *Mazarredia*, Bol. (p. 138)

C.C.—Pronotum truncate in front or scarcely obtuse angulate ; posterior angle of lateral lobes turned down ; more or less rounded, not at all obliquely truncate or spined ; third article of posterior tarsi usually shorter than the first article.

IV.—Subtribe *TETTIGINÆ.*

N.—Vertex wider or as wide as eye, viewed in profile more or less angulate produced before the eyes. (Plate III., figs. 14–14*b*.)

Gen. *Tettix*, Charp. (p. 141)

N.N.—Vertex narrower than one of the eyes, the front margin truncate, not at all produced before the eyes.

Gen. *Paratettix*, Bol. (p. 144)

O.—Head appreciably exserted ; vertex elevated forward ; antero-dorsal margin of pronotum not advanced to the eyes. (Plate II., figs. 10–10*b*.)

Euparatettix, gen. nov. (p. 145)

O.O.—Head not at all exserted ; facial frontal costa viewed in profile more or less arcuate produced before the eyes, not sinuate ; antennæ inserted between the eyes. (Plate III., fig. 18.)

Gen. *Hedotettix*, Bol. (p. 148)

P.—Front margin of vertex imperfectly carinated, narrowed forward.

Gen. *Coptotettix*, Bol. (p. 152)

I.—Subtribe *CLADONOTINÆ*.

Deltonotus, gen. nov.

Plate I., figs. 2–2*a*.

Body rather shiny, rugulose, punctate. Face broad, viewed in profile scarcely oblique ; eyes triangular conico-rotundate, not exserted. Antennæ short, filiform, widely separated, inserted below the eyes. Vertex obtuse angulate ; facial frontal costa distinct above, strongly triangularly scutellate, advanced before the eyes. Pronotum acute tectiform, subcompresso-cristate with lateral surfaces flattened ; dorsal margin of crest above gently arcuate, in profile anteriorly angulate produced, posteriorly angulate, abbreviated ; median carina of pronotum distinctly elevated. Femora entire, margins of posterior tibiæ armed with distinct spines ; first article of posterior tarsi fully twice the length of the third.

Related somewhat to *Piegotettix*, Bol. (from the Philippines), but it is readily distinguished from that genus by its much smaller stature, the form of the pronotum and other characters as shown by the figures and description. So far as known this genus is confined to Ceylon and is monotypic.

1.—*Deltonotus tectiformis*, sp. nov.

Plate I., figs. 2–2*a*.

Body small, somewhat shining, rugulose punctate. Vertex nearly twice the breadth of one of the eyes, viewed in profile obtuse angulate, considerably advanced before the eyes ; the crown of head elevated above the eyes about one-third their height and covered by the produced anterior margin of the pronotum ; frontal costa strongly triangularly scutellate, furcate a little above the middle of the eyes, the rami diverging substraight,

lightly arcuate below, viewed in profile straight. Antennæ short filiform, penultimate article a little compresso-ampliate, inserted below the eyes and separated nearly as widely apart as the eyes appear in front at their upper inner margins. Eyes of moderate size triangular conico-rotundate, with distinct apices. Palpi compressed apically. Pronotum minutely punctate, granulate, subvenate-foliate; dorsum lightly arcuate longitudinally, compressed, strongly tectiform, viewed from in front deltiform or acute tectiform, with straight sides, anteriorly angulate produced slightly extended beyond the head, antero-dorsal margins concave; the sides of dorsum rarely with faint elevated rugæ or vein-like markings, the process posteriorly subacute angulate abbreviated; median carina of pronotum elevated, cristate anteriorly more or less provided with rows of minute translucent punctulations appreciable when viewed against the light; infrascapular area below the lateral carinæ broad, inferior margin obliquely excised and sharp, inferior sinus small, rather deep; posterior angles of lateral lobes rounded externally. Anterior femora entire, slender; middle femora entire carinate; hind femora moderately broad, superior carina posteriorly slightly elevated subserrulate; first articles of the posterior tarsi more than twice the length of the third.

Length of body ♀, 8·5–9 mm.; posterior femora 5·5–6 mm.; pronot. 7·5–8 mm. ♂, Body 7·5 mm.; post. fem. 5 mm.; pronot. 7·5 mm.

Three females and two males from Pundalu-oya were taken by E. E. Green in May, 1903, "among fallen leaves under shade trees." Three nymphs (?) were also found at Hantane in March "among dead leaves on the ground in jungle." Two of these larger young, a male and female, appear in the last larval stage, while the remaining one is in an earlier stage.

This interesting apterous species presents in the nymph a shortened pronotum anteriorly leaving the head uncovered above, which at first sight might cause it to be mistaken for the adult of a different species.

Genus *Cladonotus*, De Saussure, 1860.

Plate I., fig. 1.

Body provided with spiniform tubercles. Face slightly oblique; distance between the antennæ greater than from the eyes; frontal scutellum concave, the rami subcompressed, a little elevated, entire or dentate; vertex nearly twice the breadth of one of the eyes, subtruncate on either side with small tooth. Pronotum strongly rugose, angulate in front, covering occiput,

posteriorly truncate, the apex not or scarcely reaching the apex of femora: dorsum before the middle acutely tectiform often produced in a ramose process. Elytra and wings absent. Femora scabrous, carinæ acute lobate; anterior tibiæ lineate, base slightly ampliate; genicular tooth of posterior femora strong, acute; posterior tibiæ spinose and indistinctly serrulate; first and third articles of posterior tarsi subequal in length.

Cladonotus, De Saussure (1860, p. 478).

Cladonotus, Bolivar (1887, p. 208).

Key to Cladonotus Species.

Pronotal ramus curved forward, frontal margin forming a distinct semi-circle, posterior margin strongly oblique. (See Bolivar, 1887, plate I., fig 10), *humbertianus*, Bol.

Pronotal ramus scarcely at all curved forward, frontal margin little compresso-laminate, expanded above near the summit, posterior margin vertical (plate I., fig 1), *latiramus*, Hanc.

2.—*Cladonotus humbertianus*, De Saussure.

Body black, small and stout. Head very short, vertical, large, very irregular, granulate, and rugose. Eyes globose and far apart. Vertex large, very short, retracted under the border of the pronotum, anterior border transversely carinated, granulate, and not advanced so far as the eyes, on either side terminating by a small tooth directed upwards. Face vertical, rough, divided by a bidentate carina above, the two rami between the antennæ slightly elevated, divergent, the space between concave, oval, excavate, the facial carina below the median ocellus distinct. Pronotum strongly rugose, dorsum strongly elevated forwards forming a very acute toothed carina, the summit a little in advance of the middle; the crest elevated in a long ramose appendix having the form of an apophysis, compressed, and laminate, ascending almost as long as half the body, curved forwards and terminating by a three-spined and three-toothed truncature which is directed towards the front, the apical produced margin presenting a large spiniform bifurcation directed upwards; the anterior border of the appendix a little toothed, forming with the anterior prolongation of the pronotum a half circle, the posterior border having two angles, two or three spined; anterior extremity of the pronotum prolonged above the head in an acute angle, its crest armed with four or five spines and terminating above the vertex by a spine directed forwards; sides of pronotum rugose granulate and tuberculate, the lateral lobes prolonged in the form of an acute triangular tooth, the posterior border sometimes dentate;

pronotum posteriorly large, truncate at the extremity, extended as far as the abdomen, and provided with two spines; the base presents two strong depressions between which the denticulate dorsal crest disappears, surface smooth, somewhat arcuate; median carina wanting or indistinct and strongly rugose, with two transverse rugulæ irregular and indistinct in form; humeral angles very distinct and strongly denticulate, the posterior border slightly raised, lateral borders or infra-scapular area vertically flattened, broad, and strongly punctate. Anal plates compressed and triangular, acute at apex, and sloping below. Anterior legs a little dilated, both borders two or tridentate; posterior legs enlarged strongly rugose the oblique tubercles becoming gradually spinose, knees surmounted by a large triangular acute process and preceded by a similar tooth, the external pagina furnished with two or three long spines besides other smaller ones, the inferior femoral border finely denticulate, spines of posterior tibiæ large. Elytra and wings absent.

Length of body ♂, 8 mm.; pronot. 7 mm.; post. fem. 5 mm.; pronotal ramus 3–4 mm.

Locality. Peradeniya and Trincomalee in Ceylon (De Saussure).

Cladonotus humbertianus, De Saussure (1860, p. 478).

Cladonotus humbertianus, De Saussure, Bolivar (1887, p. 209, plate I., fig. 10).

Cladonotus humbertianus, Sharp (1895, p. 301, fig. 180*b* copied from Bolivar).

The above description is adapted from De Saussure, who states that this species lives upon the sand in the meadows in the hot region of Ceylon, and he further adds that the spines, tubercles, apophyses, and even the ramose appendix of the pronotum, vary much in form and size; the former being often absent in many parts.

3.—*Cladonotus latiramus*, sp. nov.

Plate I., figs. 1–1*a*.

Resembling the preceding species. Body small, stout, fuscous, strongly rugose spinose. Vertex rugose, equal to about twice the breadth of one of the eyes, scarcely narrowed toward the front, not advanced quite so far as the eyes, in front indistinctly transversely carinate, minutely subdenticulate, on either side outwards next to eye provided with a small tooth. Eyes viewed in profile globose, viewed in front a little triangularly laterally exserted. Face vertical, between the eyes widely depressed; facial frontal costa above at the vertex little minutely subdenticulate, presenting between the upper third of the eyes a small tooth, another tooth

appearing on a plane little below the middle of the eyes; the rami of scutellum widely arcuately divergent, in profile between the antennæ compresso-protuberant but flattened; the median carina of face below distinct. Antennæ slender, filiform, articles elongate inserted far below the eyes but separated apart a distance little wider than from the eyes. Pronotum rugose, in front acute spinose produced over the head, compresso-tectiform, armed with teeth, forming the anterior basal portion of the pronotal ramus; dorsum of pronotum anteriorly before the shoulders elevated into a nearly vertically produced quadricarinate ramus, about four millimeters in height, slightly expanded forward toward the upper extremity, the posterior border transversely widened by the presence of two strong supernumerary carinæ, running the entire length, compressed, viewed from behind irregularly serrate; ramus near the base slightly constricted, anterior margin in profile below presents a concavity and armed with spines and little crateriform elevations, upper anterior part sub-convexo-angulate, presenting four small teeth which mark the terminations of short oblique distinct, but alternately placed veins or rugæ, the short margin of summit above incurved; posterior ramosal margin vertical, viewed from behind the large compresso-lateral irregularly serrate carinæ conspicuous; median ramosal carina behind becoming distinct below as it descends backwards to form the base, here it is slightly elevated, sloping backwards, irregularly minutely multispinose; dorsum of pronotum anteriorly slightly compressed, laterally sloping but deeply sulcate, anterior prozonal carina absent; below base of ramus on either side of the ascending vertical carinæ fossulate, behind the shoulders transversely fossulate; pronotum lightly narrowed posteriorly, extended backwards little beyond the middle of hind femora, distinctly truncate behind, emarginate-carinate, minutely crenulate-dentate, on either side at the apical angles armed with a small tooth, dorsal surface between the carinæ punctate and traversed by transverse W-shaped rugæ; infra-scapular area broad high, and slightly arched above, laterally flattened, rugose granulate, narrowed posteriorly, prolonged around but below the apical marginal carinæ; posterior angle of lateral lobes of pronotum widely obliquely produced downwards, distinctly angulate, obliquely truncate behind, serrate, the outer margins serrulate. Anterior femora compressed, upper margin provided with two small serrate lobes, the inferior margin armed with three distinct acute lobes, their margins serrate, the apical margin armed with a small tooth; middle femora not quite so compressed, armed above with two small serrate lobes, besides being distinctly spined at the apex,

below with three acute lobes increasing in size toward the extremity, the lower carina at the apex acute ; posterior femora robust, rugose, armed with spines, the superior margin arcuate, denticulate, posteriorly armed with a strong triangular genicular spine, a similar one just preceding but not quite so acute ; knee outwardly armed with two apical teeth, transverse ridges of external pagina with one small and two large spines, the latter having strong bases, the inferior margins crenate-dentate ; posterior tibial margins serrulate, armed with strong spines, the inner spines interrupted near the apex, the outer spines, above five, scattered ; first and third articles of posterior tarsi subequal in length, the first and second pulvilli acute.

Length of body 9 mm.; post. fem. 4·75 mm.

A single male from Kandy taken by Mr. Green "on bungalow wall" in August, 1903.

An excellent figure of *Cladonotus humbertianus*, De Saussure, given by Bolivar (1887, plate I., fig. 10), drawn from the type offers an opportunity of comparing the species with the figure of this interesting species. The main difference lies in the form of the pronotal ramus, which is well characterized as before-mentioned in the key to the species.

II.—Subtribe *SCELMENINÆ*.

Gen. *Scelimena*, Serv., 1839.

Plate I., figs. 5-5*c*.

Body sparsely granulate. Face moderately declivous ; antennæ inserted distinctly below and in advance of the lower margin of the eyes; superior ocelli situated scarcely in front of the eyes ; frontal costa moderately divergent, compresso-elevated between the antennæ. Vertex with an oblique carinula on each side. Eyes moderately exserted, higher than the vertex. Pronotum with the dorsum depressed ; posterior angles of the lateral lobes armed with an acute spine directed outwards. Elytra oblong ; wings perfectly explicate extending nearly to the pronotal apex. Femora narrow ; the posterior femora more or less lobate ; posterior tibiæ strongly ampliate towards the apex, margins laminate, internal margin unarmed, external margin often furnished with small denticles ; first article of posterior tarsi laterally expanded.

Members of this genus are amphibious in their habits as previously described.

Scelimena, Serville (1839).

Scelimena, Bolivar (1887, p. 215).

Scelymena, De Sauss. (1860, p. 480).

Tettix, Stal (1875, p. 150).

KEY TO SCELIMENA SPECIES.

Vertex of head strongly narrowed towards the front, small frontal carinulæ distinctly obliquely convergent, angulate; posterior angle of lateral lobes of pronotum armed with one strong spine; femoral margins below armed with more or less reduced teeth; body, usually shining black, mingled with light granules, margined with red (plate I., fig. 4); *gavialis*, De Sauss.

Vertex sensibly wider, the frontal carinulæ oblique, but the front margin more subtruncate; lateral lobes of pronotum laminato-bidentate; apex of pronotal process bispiniform; both margins of anterior femora, the lower margins of middle and posterior femora armed with strong teeth; body usually grayish flavous mottled with fuscous, teeth and margins often yellowish. (Plate I., fig. 5); *logani*, sp. nov.

4.—*Scelimena gavialis*, De Saussure.

Plate I., figs. 4–4*c*.

Body moderately large, long attenuate posteriorly. Face sensibly retreating; eyes globose, slightly prominent but drawn near together. Vertex depressed, strongly narrowed toward the front, not advanced quite so far as the eyes, the anterior half distinctly sloping forward and on either side longitudinally fossulate; the small elevated oblique carinulæ conspicuous from above, but hidden in profile by the eyes, converging forward so as to form a very narrow angulate anterior border, between the eyes slightly interrupted by the forward sloping of the slightly conspicuous median carina, the latter very little projects in front extending backwards half the length of the vertex. Facial frontal costa above between the eyes distinct, but not advanced here quite so far as the eyes, precipitately sloping forward, between the antennæ roundly protuberant, the rami narrowly divergent to the median ocellus, median facial carina below distinctly reduced; posterior ocelli conspicuous in profile, situated barely in front and on a plane with the lower third of the eyes. Antennæ from four to four and three-quarter millimeters in length, filiform, middle articles strongly elongate, the first basal article flattened, the second small and globular; inserted below the eyes and in a vertical plane scarcely behind their anterior borders. Palpi very little compressed apically. Pronotum somewhat shining densely granulate, truncate in front, long attenuate acute posteriorly, subhorizontal or very slightly upturned toward the apex; dorsum flattened, between the shoulders transversely very lightly irregularly subconvex, the breadth from three and three-quarters to five

millimeters; between the lateral carinæ presenting three pairs of lightly elevated, ill-defined protuberances of nearly equal distance apart; the first pair between the shoulders often surmounted by very thin variable short longitudinal supernumerary carinula, substraight; the second somewhat smaller pair, in profile, little elevated, situated in a plane drawn just behind the elytra, sometimes presenting obscure or short line on the summits; the third pair often inconspicuous, appear at about an equal distance behind; between the frontal portion of the shoulders anteriorly, and behind each of the first and second pairs of dorsal protuberances slightly fossulate; median carina of pronotum slightly conspicuous very slightly elevated, irregularly undulate, posteriorly straight, obliterated forward just behind the front margin, sometimes a very little compresso-elevated in front and between the shoulders; humeral angles strongly obtuse, the lateral posterior apical carinæ often continued forward on the shoulders as a supernumerary enclosing a narrow scapular area; above the infra-scapular area the shoulders being lightly bicarinate on each side; anterior prozonal carinæ short straight, distinctly reduced but not obsolete; infra-scapular area narrow above the elytra, subsulcate; lateral apical carinæ posteriorly subobliterated, apex slightly obtuse or barely bifurcate; posterior angle of lateral lobes of pronotum armed with one strong curved spine directed outward and forward nearly transverse; lateral lobes divided by a distinct median sulcus; the fronto-lateral margins of pronotum slightly enlarged, turned outward subtuberculate; lateral lobes posteriorly bisinuate, the elytral sinus shallow, the inferior sinus deeply angularly excavate, the posterior angle behind obliquely truncate. Elytra oblong acuminate toward the apex; wings well developed though largely concealed by the pronotum, not extended backwards quite so far as the apex of process. Anterior femora slender a little compressed, ampliate toward the base, inferior marginal carina provided with two more or less variable tubercles or teeth; middle femora slender, externally carinate above, but just below the superior marginal carina, margin below armed with two teeth; posterior femora of moderate size granulate, superior marginal carina lightlya rcuate, crenulate, near the apex provided with two obscure ante-genicular teeth, genicular spine slightly prominent, inferior marginal carina armed with three or four more or less distinct teeth, the one behind the middle being conspicuous acute, directed backwards; posterior tibial margins strongly expanded laterally, minutely crenulate, internal margin unarmed, external margin sometimes with one to five scarcely perceptible minute spines, lateral margins of first article of

posterior tarsi strongly dilated, first article distinctly longer than the third, first and second pulvilli equal in length, acute, the third a little longer. Colour shining black mingled with light granulations. The anterior borders of pronotum, the lateral lobes with their spines, the sides above the elytra, the apex of pronotal process, the spines on femoral margins, portions of the face and palpi are all beautiful coral vermillion, or rose tinted; the under parts of body being marbled somewhat lighter.

The following measures in millimeters show the range of variations in eight females and six males:—

Sex.	Length of Body.	Pronotum.	Shoulders.	Elytra.	Post. Fem.	Antennæ.	Pronotum plus Wings.
♀	27·	26·	5·	3·4	9·	—	—
♀	24·5	23·5	4·75	3·	8·	—	—
♀	26·	25·	5·	3·	9·	—	·5
♀	24·2	23·2	4·5	2·8	8·5	—	·4
♀	23·4	22·1	4·3	3·	8·4	4·	·0
♀	24·8	23·5	4·5	3·	8·9	—	·4
♀	25·5	24·5	5·	2·9	8·9	4·5	·5
♀	25·5	24·5	4·75	3·	9·	4·75	·5
Range	23·4–27·	22·1–26·	43·–5·	2·8–3·4	8·–9·	4·–4·75	0–·5
♂	23·	22·	4·	2·5	7·2	—	·5
♂	21·1	20·	3·75	2·5	7·	—	·3
♂	21·5	20·1	4·	2·1	7·	4·5	·0
♂	22·3	21·2	3·9	2·6	7·	4·2	·2
♂	21·5	20·3	3·75	2·3	7·	4·3	·2
♂	22·	21·	4·	2·3	7·1	4·3	·2
Range	21·1–23·	20·–22·	3·75–4·	2·1–2·6	7·–7·2	4·2–4·5	·0–·5

De Saussure gives the following measurements: ♀, Length of body 26 mm.; pronotum 25 mm.; width of pronotum at shoulders 5 mm.; post. fem. 9 mm. ♂, Length of body 23·5 mm.; pronotum 22·3 mm.; width of pronot. at shoulders 4 mm.; post. femora 7·7 mm.

Locality, Peradeniya; October and November (De Saussure). Of the above tabulated specimens one female, Dambulla, October, "from margin of tank;" two females, Maskeliya, November and February; five females and four males, Pundalu-oya, March, were taken "from rocks in mountain streams; when disturbed, either takes wing, or dives under water and remains submerged for some time; larva in similar situations." Two more males and several nymphs were taken in June from the same locality.

The young, even in the early stages, are easily distinguished from *Scelimena logani*, the next allied species, by the narrower vertex, the smoother body, and absence of very distinct teeth on the lower margins of femora. The adults furthermore differ from

logani in the following particulars, namely, by the more shining black, densely granulate pronotum; the distinct red border markings; the stronger narrowing of vertex of head; in the presence of but one curved spine, arming the lateral lobes; the more slender femora; the teeth of lower margin of femora, but lightly developed; lateral margins of posterior tibiæ less appreciably dilated.

Scelimena gavialis De Saussure (1860, p. 485).

Not *Scelimena harpago*, Serv. Bolivar (1887, p. 217).

5.—*Scelimena logani*, sp. nov.

Plate I., figs. 5–5*c*.

Allied to *Scelimena gavialis*, De Saussure. Body moderately large, granulate, long extended posteriorly attenuate acute. Face retreating; eyes subglobose, little exserted. Vertex narrowed toward the front, much narrower than eye, but wider than in *gavialis*, depressed and declined forward, the anterior half lightly longitudinally canaliculate on either side, frontal margin subtruncate not advanced quite so far as the eyes, the short oblique frontal carinulæ converging forward, little bent inward at the front margin, interrupted by the slightly conspicuous median carina of vertex. Frontal costa roundly protuberant between the antennæ, moderately sulcate, the rami diverging forward substraight, above between the eyes distinct but not advanced. Posterior ocelli conspicuous in profile before the lower angle of the eye. Antennæ filiform, inserted below the eyes and in a vertical plane scarcely behind their anterior borders; palpi little compressed apically. Pronotum granulate, not shining as in the preceding species *gavialis*, but presenting in a similar way, a truncate frontal margin, and three pairs of dorsal protuberances, with more distinct little longitudinal supernumerary carinulæ surmounting each summit; often these lines become to a certain degree furcate, sending out minute secondary carinulæ, the second pair outwardly coalescing with the lateral carinæ; dorsum at the shoulders bicarinate enclosing a narrow scapular area; the anterior prozonal carinæ short, little subdiverging backward; the frontolateral margins not at all enlarged or appreciably tuberculate; extreme apex of pronotal process bispinose acute; inferior margins of lateral lobes of pronotum outwardly slightly dilated, a little before the posterior angle provided with a tooth, besides the posterior angle of lateral lobe armed with a strong produced spine curved little forward acute, posteriorly obliquely truncate, serrulate. Elytra oblong acuminate apically; wings extended nearly or about to the pronotal apex. Anterior femora granulate, little compresso-ampliate, superior margin cut by two distinct

serrations, margin below with two distinct teeth dividing the entire length into thirds; middle femora slender, above subsulcate-carinate barely subsinuate, the second distinct carina taking a parallel course above, inferior marginal carina armed with two strong teeth, the second at the distal third often longer spinose, subacute, directed backward; posterior femoral margin above serrulate, with two distinct antegenicular serrations, genicular spine somewhat strongly developed, inferior margin strongly armed with variable teeth or spines, from five to six in female, the second tooth before the knee often largest triangular acute, its posterior border sometimes serrulate at base, the antegenicular tooth often longer produced or more slender, or subspiniform acute; posterior tibial margins strongly expanded laterally, minutely crenulate, the inner margin unarmed, the external margin provided with about five scarcely discernible obsolete spines; first article of posterior tarsi with the lateral margins widely laminately expanded minutely crenulate, first article longer than the second, the first and second pulvilli small, acute, the third little longer.

Colour grayish or yellowish infuscated, anterior margins of pronotum and lateral lobes and the teeth of femora dusky yellow.

Measurements in Millimeters.

Sex.	Length of Body.	Pronot.	Shoulders.	Elytra.	Post. Fem.	Antennæ.	Pronot.+ Wings.
♀	24·3	23·2	5·	2·9	8·5	4·75	·0
♀	25·	24·	5·	3·	8·5	—	·2
Range	24·3–25	23·2–24	5·	2·9–3	8·5	4·75	·0–·2
♂	20·9	20·	4·	2·5	7·	4·3	·2
♂	19·8	18·5	4·	2·3	6·75	4·	·3
♂	21·3	20·3	4·3	2·5	7·	4·1	·4
♂	20·6	20·1	4·	2·5	7·	4·2	·0
♂	20·8	19·9	4·	2·4	6·75	4·	·2
♂	20·	19·9	4·	2·3	6·9	4·	·2
Range	19·8–21·3	18·5–20·3	4·–4·3	2·3–2·5	6·75–7	4–4·3	·0–·4

Two females and five males taken at Kandy, Mahaweli-ganga in January, one in June, with a number of nymphs.

"Aquatic; on rocks." A single male "from rocky stream" was taken at Haragama in January by Mr. E. Ernest Green.

Judging from the foregoing this species has aquatic habits similar to those of *Scelimena gavialis*, De Sauss., and this supposition is borne out by the structure of the posterior legs, which are widely laminate expanded at the lateral margins of the tibiæ and first joint of the posterior tarsi, being in this particular even little more specialized than in *gavialis*.

A young specimen taken in January, which is apparently in the last pupa stage, just preceding the imago, has the dorsum of pronotum rough, provided with protuberances ; the median carina of pronotum a little accentuated and distinctly sinuate, little arcuate posteriorly ; the apical process terminating acutely. The lateral lobes of pronotum at the inferior margins outwardly convex, the posterior angle being unarmed, having neither tubercle or spine, but distinctly angulate.

I am not sure but De Saussure (1860, p. 486), included this species as a variety of *Scelimena gavialis*, where he states : " Variat pronoti lateribus bispinosis vel femoribus posticis submuticis," and moreover where he says : (p. 487) " Un autre, qui est plus fortement peint de rouge, a une seconde petite épine aux lobes lateraux du prothorax, et une ou deux dents aux bords supérieurs des cuisses antérieures ; les dents des bords inférieurs sont aussi plus fortes." No red colouring whatever appears on any of the eight specimens I have recorded above though present in all the *gavialis* specimens.

This species is dedicated to Mr. F. G. Logan of Chicago in token of his patronage of Art and Science.

Gen. *Gavialidium*, De Sauss., 1860.

Plate I., figs. 11-11*b*.

Differing from *Scelimena*, Serv., as follows : posterior angles of the lateral lobes of pronotum outwardly laminato-expanded, one or tridentate, rarely widely truncate. Femora compressed, superior and inferior carinæ more or less lobate ; margins of posterior tibiæ compressed, almost unarmed or provided with minute denticles on the exterior margins ; first articles of posterior tarsi flattened above, but the margins obtuse not laminato-produced.

Tettix, pars, Stal.

Scelymena (*gavialidium*), De Saussure (1860, p. 481).

Gavialidium, Bolivar (1887, p. 218).

Key to Gavialidium Species.

Body moderately large, distinctly flattened above, prolonged backwards, upturned at the apex of pronotal process ; dorsum posteriorly rugose granulate reticulate ; facial frontal carina below the median ocellus obliterated. (Plate II., figs. 11–11*b*.)

crocodilus, De Saussure.

Body smaller, rougher, process abbreviated ; lateral lobes of pronotum trilobate ; carinæ barely crenulate ; median carina elevated undulate, subcristate ; occiput without tubercles ; facial carina below the median ocellus distinct ; pronotal process with four oblique strongly rugose elevated tubercles

alligator, De Saussure.

6.—*Gavialidium crocodilus*, Sauss.

Plate II., figs. 11-11*b*.

Body strongly rugose, reticulate, granulate, cribriform. Head small, rugose granulate. Eyes small, globose little exserted, posterior ocelli conspicuous in profile little before the anterior inferior angle of the eye. Vertex nearly horizontal, strongly wider than eye, not appreciably narrowed, not advanced quite so far as the eyes, the front margin truncate, the middle imperfectly carinate outwardly on each side compresso-elevated acute, little higher than the eyes, occiput rugose. Face retreating, the facial frontal costa above between the eyes reduced obsolete not advanced, in profile between the antennæ strongly roundly protuberant, the rami rather widely separated, divergent forward substraight, carina below the median ocellus obliterated. Antennæ filiform very slender, articles elongate, inserted below the eyes a distance equal to half their height, on a vertical plane little in advance of the anterior border of eyes. Pronotum truncate in front but the dorsal front margin subtrituberculate, strongly prolonged backward attenuate acute, elevated at the apex; dorsum strongly flattened above, rugose, reticulate cribriform excoriate; median carina of pronotum moderately distinct, but interrupted between the shoulders by a fossa; just before the fossa little compresso-elevated crenulate; the little crest cut by an excavation dividing off a small, but distinct crenate tubercle anteriorly; just behind the dorsal front margin reduced, crenulate, posteriorly behind the shoulders very slightly unevenly elevated, rugose-sinuate granulate, on the apical process subobsolete; lateral carinæ elevated, posteriorly convergent nearly straight, crenulate; the humeral angles armed with a small denticle and another minute denticle before the shoulders; midway between the anterior border of pronotum and humeral angle incised by a very deep vertical sulcus; prozonal carinæ short conspicuous crenulate, little subdivergent backwards, in front terminating in little acute tubercle; humeral angles of pronotum strongly obtuse little outwardly produced; dorsum anteriorly on either side of small median crest fossulate, between the shoulders provided with little reticulate crenate protuberances; two more lightly elevated rough reticulations appear posteriorly on each side between the carinæ; lateral lobes with the anterior angle dentate, the inferior margin outwardly widely and somewhat roundly laminate crenate, tricuspidate or armed with two distinct teeth, rarely with a small one anteriorly, the posterior angle acute subdentate, behind suboblique truncate; infra scapular area rather high, the humero-apical carina obscured, sides of apical process high, vertically flattened precipitous; elytral sinus

small, the inferior sinus large and angularly excavate. Elytra very small, lanceolate; wings not reaching to the pronotal apex, very largely concealed. Anterior femoral margins above armed with three strong teeth, minutely serrate, at the base often presenting small, secondary denticles, below strongly bi- or tri-dentate-lobate; middle femora not so compressed, margin above triserrate the first two teeth distinct acute, the third smaller, below strongly bidentate acute or subspinose; posterior femora narrowed behind, the knee small, femoral margins crenate above arcuate anteriorly, straight posteriorly, presenting two distinct obtuse teeth, lower margin provided with one obscure denticle; tibial margins not appreciably dilated, serrulate unarmed; first article of posterior tarsi very slender little lower than the third, the first pulvillus small acute, widely separated from the second, the second small acute, the third flat below. There are marked variations in the size and arrangement of the teeth of the femora which may be more or less deficient or strongly developed, being sometimes lobuliform, spiniform, or dentiform. The teeth moreover differ on one side from those of the opposite side and in one sex from the other. A correlation is shown in a similar tendency of the teeth to vary on the inferior margin of the lateral lobes of the pronotum, where the second tooth is more often spiniform, or sometimes the margins are distinctly tridentate; the anterior lateral margins not infrequently present one or two additional tubercles.

Measurements in Millimeters.

Sex.	Length of body	Pronot.	Shoulder.	Elytra.	Post. Fem.	Antennæ.	Pronot. + Wings.
♀	24·	23·	4·5	2·	7·2	—	1·75
♀	21·5	20·5	4·3	2·	7·	5·	1·
♀	24·	23·	4·5	2·1	7·3	—	2·
♀	22·	21·	4·2	2·	6·8	5·	2·
♀	22·3	21·3	4·1	2·	7·	4·5	1·5
♂	20·8	19·8	3·5	1·8	6·	—	2·
♂	19·7	18·7	3·8	1·8	5·8	—	1·75

Five females and two males taken in March, April, and June, Pundalu-oya, "from rocks over which oozy water trickles; insect seldom actually wet; very sluggish, seldom takes wing." E. E. Green. Numerous larvæ in various stages. Kadugannawa (De Saussure).

Scelymena crocodilus, De Saussure (1860, p. 481).

Gavialidium crocodilus, Bolivar (1887, p. 219).

De Saussure (1860, p. 483), gives the following dimensions: ♀, Length of body 23·5 mm.; pronot. 22 mm.; width of shoulders 4·6 mm.; post. fem. 7·3 mm.; ♂, Length of body 19 mm.; pronot. 18·5 mm.; breadth of shoulders 3·5 mm.; post. fem. 6·2 mm.

7.—*Gavialidium alligator*, Sauss.

Very similar to *crocodilus* but smaller. Vertex similar, likewise presenting an acute tooth on each side next to the eyes, but the occiput deprived of tubercles. Facial carina distinct below the median ocellus. Pronotum having the same form, similar angles but more rugose, and less flattened above owing to the median carina being more elevated, continuous throughout as far as the apex of the process, the latter abbreviated; the median carina strongly undulate, lobed, rugose in the first half or even beyond; the small anterior prozonal carinæ parallel strongly elevated, but little or not at all crenulate; humeral angles armed with a tubercle; the lateral carinæ before the shoulders very distinct, and suddenly interrupted by the posterior sulcus; the lateral borders of process very acute, cariniform, but not denticulate; lateral lobes of pronotum strongly rugose tuberculate, terminating by three equal lobules; surface of process very rugose, presenting four oblique tubercles in the form of elevated ridges, but the lateral margins less distinct than in *G. crocodilus*. Posterior femora less dentate and stouter, showing moreover on the external pagina a small tubercle. Length of pronotum ♂, 19 mm.; breadth of shoulders 3 mm.; post. fem. 5·4 mm.

Locality, Ceylon (De Saussure).

Scelymena (*gavialidium*) *alligator*, De Saussure (1860, p. 483).

Gavialidium alligator, Bol. (1887, p. 219).

Lamellitettix, gen. nov.

Plate II., figs. 6–6*b*.

Related to *Mazarredia*, Bolivar. Body flattened above, rugose gibbocristate, tuberculate granulate. Head little elevated, face very slightly retreating, the frontal contour in profile sinuate. Vertex subtruncate in front, viewed in front strongly concave, viewed from above slightly wider than eye but not so far advanced, little frontal carinulæ outwardly compresso-elevated acute. Frontal costa above between the eyes not advanced, distinctly protuberant between the antennæ, viewed from in front narrowly sulcate, the rami little divergent substraight. Eyes globose conspicuously exserted. Antennæ unusually long slender filiform, articles strongly elongate, inserted just below the eyes, but scarcely behind a vertical plane with their anterior borders; posterior ocelli situated between the lower third of the eyes, subobscured in profile by the eyes, viewed in front very evident. Pronotum in front truncate, posteriorly extended scarcely beyond the wings acute, dorsum above flattened, anteriorly constricted; humeral angles distinct carinate, produced very slightly outwards, lightly depressed; lateral lobes of pronotum with distinct sulcations,

posterior angle strongly triangularly laminate produced outwards, acute subspiniform, posteriorly subobliquely truncate. Elytra oblong ; wings explicate. Anterior femora slender entire ; middle femora slender margins above subundulate below entire, externally bicarinate ; posterior femora rather slender the external pagina provided with obliquerugulæ above with rounded tubercles, margins serrulate, above before the knee acute, at the apex of femora armed with a large acute genicular spine ; posterior tibial margins serrulate lightly compressed, armed with small feeble spines ; first and third articles of posterior tarsi equal in length, pulvilli flat below. Ovipositor unusually long, the blades slender strongly denticulate.*

8.—*Lamellitettix acutus*, sp. nov.

Plate II., figs. 6–6*b*.

Body of medium size ; pronotum flattened above gibbocristulate, rather stout between the shoulders, rugose tuberculate granulate. Head slightly retreating, short, little elevated. Eyes of moderate size distinctly globose, prominently exserted. Vertex viewed from above little wider than one of the eyes, hardly subnarrowed depressed towards the front, lateral margins lightly sinuate widened posteriorly, frontal margin subtruncate, viewed in front roundly concave, viewed from above not advanced so far as the eyes, little carinulæ on each side outwardly distinctly rounded compresso-elevated acute, not visible in profile ; at the lateral margins just behind the fronto-lateral carinulæ presenting minute supraocular lobes ; median carina of vertex appreciably distinct though reduced, roundly sloping forward ; between the eyes little fossulate on each side, backward terminating by very light occipital rugose protuberances. Facial frontal costa above between the eyes not at all advanced, between the antennæ distinctly roundly protuberant, viewed in front narrowly sulcate, the rami slightly divergent substraight, facial carina distinct, in profile lightly excavate just below the median ocellus. Superior ocelli situated between the lower third of eyes, in profile almost obscured by the eyes. Antennæ filiform unusually long slender, articles strongly elongate, inserted just below the eyes but scarcely behind a vertical plane with their anterior borders. Pronotum truncate in front, posteriorly strongly extended beyond the knee of posterior femora acute, slightly passing the wings at the apex ; dorsum between the shoulders rather broad trigibbocristate, humeral angles distinct outwardly subproduced little depressed ;

* This genus has certain characters common to the Metrodorinæ : for instance, it has the length of the first and third articles of the posterior tarsi equal, but the strongly triangularly laminate produced posterior angles of the lateral lobes of pronotum lead one to place it with the Scelimeninæ.

median carina of pronotum strongly interrupted cristate undulate, just behind the humeral angles compresso-elevated gibbocristate the summit slightly flattened ; just in front of the crest slightly convexo-elevated, just behind the antero-dorsal margin subobliterated, between the anterior sulci strongly depressed ; backward just behind the crest the median carina distinctly depressed, posteriorly undulate, with three separated compresso-elevated obtuse tubercles ; about four or five smaller tubercles gradually becoming obsolete backward toward the apex ; on either side of the median anterior gibbose-crest and situated little forward between the humeral angles the dorsum distinctly compresso-elevated gibbocristulate, in profile convexly sloping forward, behind obliquely excised, the summit viewed from above with a short supernumerary subdiverging carinula ; the lateral dorsal carinæ distinct little elevated prolonged forward inside to or little beyond the humeral angles as secondary carinulæ, behind the shoulders over the elytra distinctly sulcate bicarinate; antehumeral carinæ distinct ; anterior prozonal carinæ short, distinctly compresso-elevated crenulate ; dorsum in front of the shoulders subfossulate, behind the shoulders strongly flattened on each side with a slightly oblique elevated tubercle, posteriorly rugose, granulate, subtuberculate ; infra-scapular area of moderate height, above subbicarinate, little arcuate scarcely subnarrowed forward, attenuated behind ; lateral lobes of pronotum distinctly trisulcate, the anterior sulcus continuous above on the dorsum forming a strong constriction ; posterior or elytral sinus shallow, the inferior sinus largely angularly excised ; posterior angle of lateral lobes strongly outwardly laminate, triangularly acute produced spiniform, posteriorly subobliquely truncate. Elytra oblong subobtuse apically ; wings well developed not quite reaching to the apex of frontal process. Anterior femora slender entire ; middle femora slender margins subundulate, externally bicarinate ; posterior femora rather slender, external pagina provided with strong oblique rugulæ, above with round tubercles, margins serrulate, anterior half above subflattened provided with a small antegenicular acute tooth, apex of femora above armed with a large strong, acute, genicular spine ; posterior tibial margins serrulate, lightly compressed, armed with about five or six small spines, absent on the internal margin near the apex ; first and third articles of posterior tarsi equal in length, pulvilli flat below.

Ovipositor unusually long the blades slender strongly denticulate.

Length of body ♀, 14·3 mm. ; pronot. 13·4 mm. ; breadth of shoulders 3·5 mm. ; elytra 1·8 mm. ; post. femora 7 mm. ; antennæ 5·2 mm. ; pronot. + wings ·1 mm.

Locality, Maskeliya, Ceylon.

One female taken "from stem of tree in thick jungle, March," E. Ernest Green.

Gen. *Criotettix*, Bolivar.

Plate III., figs. 15–15*b*.

Body granulate, elongate. Vertex viewed from in front rarely lower than the eyes, above horizontal or towards the front elevated. Frontal costa just behind the antennæ not sinuate; palpi subcylindrical, same colour. Antennæ inserted barely in front of the eyes. Pronotum truncate in front, posteriorly long subulate, very rarely abbreviated; dorsum depressed, humeral angles obtuse; posterior angles of lateral lobes outwardly laminate acute rather long spinose. Elytra oblong; wings perfectly explicate. Prosternum reflexed, anteriorly widely sinuate. Anterior femora narrow, carinæ entire; femoral teeth and knee of posterior femora small; posterior tibiæ towards the apex moderately ampliate, canthus compressed, spinose; first articles of posterior tarsi above flattened distinctly longer yet narrower than the third, linear.*

Criotettix, Bolivar (1887, p. 222).

Key to Species of Criotettix.

Vertex strongly narrower than eye; pronotum granulate; face strongly retreating; spine of lateral lobe usually directed subobliquely backward. Plate III., figs. 15–15*b*, *tricarinatus*, Bol.

Vertex subequal in width to eye; pronotum subrugose granulate; frontal costa protuberant between the antennæ; spine of lateral lobe usually directed transversely or little bent subobliquely forward. Plate III., figs. 12–12*b*, *spinilobus*, sp. nov.

9.—*Criotettix tricarinatus*, Bolivar.

Plate III., figs. 15–15*b*.

Pale gray, fusco-variegated. Vertex strongly narrower than eye, middle carinate, either side in front with elevated curved carinula. Pronotum with dorsum obtuse tectiform, median carina percurrent, elevated; between the shoulders with two parallel supernumerary carinulæ, abbreviated forward and backward; posterior process long subulate; lateral lobes provided with a rather long acute spine. Elytra short ovate, apex rounded. Femoral carinæ granulate not at all lobate; posterior femora externally longitudinally striped with fuscous; tibiæ fusco-annulate; first article of posterior tarsi with the apices of the two basal pulvilli acute spinose.

Length of body ♂ ♀, 7–8·5 mm.; pronot. 10·5–12·5 mm.; post. fem. 5–6 mm. (Bolivar.)

* To this genus belong such species as *C. exsertus*, Bol., *C. tricarinatus*, Bol., *C. indicus*, Bol., and *C. oculatus*, Bolivar, &c.

Criotettix tricarinatus, Bolivar (1887, p. 224).

Criotettix tricarinatus, Bolivar (1902, p. 583; Kodiakanal, South India).

I am indebted to Professor Bolivar for a pair of this graceful species. The labels bear the single designation, Ceylon. My collection, moreover, contains two males from Pundalu-oya, Ceylon, which were kindly contributed by Malcolm Burr. A large series from E. Ernest Green, comprising sixty-nine specimens from Kandy, were collected in January; forty of them were in preservative solution. They were collected "on the banks of river." A single female, also taken in January, was "caught on railway bank" at Kadugannawa; while a pair is represented from Peradeniya, taken "from grass land" in May.

There were nearly twice as many males as females represented.

This species is exceedingly variable in colour, being frequently light grayish infuscated or maculate on the pronotum, the posterior femora often being mottled with fuscous.

The following measurements of six specimens of each sex show in a certain degree the range of the variations:—

Measurements in Millimeters.

Sex.	Length of Body.	Pronot.	Width of Shoulders.	Elytra.	Post. Fem.	Antennæ.	Wings+or —Pronot.
♂	12·	11·	2·3	1·2	5·	3·3	+·2
♂	11·75	10·7	2·2	1·1	4·8	3·5	+·0
♂	12·1	11·4	2·1	1·	4·9	3·4	—·2
♂	12·	11·	2·1	1·	5·	3·5	+·1
♂	12·5	11·9	2·1	1·1	5·	3·5	+·0
♂	12·2	10·8	2·1	1·	5·	3·7	+·6
Range	11·75–12·5	10·7–11·9	2·1–2·3	1·–1·2	4·8–5·	3·3–3·7	w+p p+w ·0–·6 ·0–·2
♀	14·5	13·5	2·7	1·3	6·	3·8	·0
♀	14·5	13·5	2·6	1·3	6·	4·	·0
♀	14·2	13·5	2·6	1·3	6·	3·8	·0
♀	14·6	13·6	2·6	1·3	6·	4·	·0
♀	13·	12·	2·3	1·2	5·5	3·7	+·2
♀	12·8	12·	2·4	1·1	5·5	3·8	·0
Range	12·8–14·6	12·–13·6	2·3–2·7	1·1–1·3	5·5–6	3·7–4	w+p ·0–·2

10.—*Criotettix spinilobus*, sp. nov.

Plate III., figs. 12–12*b*.

Nearly related to the preceding species, *Criotettix tricarinatus*, Bolivar. Body rather slender, quite small, granulate or lightly tuberculate; head not or very slightly elevated; face very slightly retreating. Vertex viewed from above nearly equal in width to one of the eyes, not advanced quite so far, frontal margin truncate,

but the carinulæ outwardly roundly curved backward, compresso-elevated abbreviated, middle carinate, subconvex, on either side little longitudinally fossulate; the crown of head little sloping behind. Frontal costa in profile above barely advanced, very lightly subexcavate before the eyes, between the antennæ appreciably protuberant, viewed in front rather narrowly sulcate, the rami subparallel. Eyes globose of moderate size. Antennæ slender filiform, inserted between the lower angle of the eyes. Pronotum truncate in front, posteriorly subulate acute, prolonged nearly as far or little beyond the wings; dorsum above subflattened, granulate subrugose or often little tuberculate posteriorly; between the shoulders provided on each side with an abbreviated supernumerary carinula; in front of the shoulders little constricted, on each side bisulcate; humeral angles obtuse; scapular area indistinct; median carina of pronotum subundulate distinct, percurrent, little elevated, straight posteriorly, a little compresso-elevated forward between the sulci; infra scapular area strongly narrowed, carina above a little curvate; lateral carinæ of pronotum distinct; posterior angles of lateral lobes armed with a distinct somewhat long slender spine directed outward transversely or slightly forward. Elytra oval apex obtuse; wings explicate extended backward just about to the apex of pronotal process or little beyond. Femora rather slender margins entire; posterior femoral margins above serrulate; posterior tibial margins compressed, very lightly armed with minute spines, absent near the apex internally; first articles of posterior tarsi very narrow, scarcely longer than the third, the first and second pulvilli spiculate, the third flat below.

Measurement in Millimeters.

Sex.	Length of Body.	Pronot.	Shoulders.	Elytra.	Post. Fem.	Antennæ.	Wings and Pronot.
♂	10·	9·	2·1	1·	4·5	3·2	·0
♂	9·8	8·9	2·1	1·	4·5	3·2	·0
♂	10·	9·	2·1	1·	4·6	3·3	·0
♂	10·3	9·5	2·2	1·	4·5	3·2	·0
Range	9·8–10·3	8·9–9·5	2·1–2·2	1·	4·5–4·6	3·2–3·3	·0
♀	12·2	11·3	2·7	1·2	5·7	—	—
♀	11·	10·2	2·5	1·1	5·2	4·	—
♀	11·5	10·5	2·5	1·2	5·5	4·	·1
♀	11·7	10·7	2·6	1·2	5·4	4·	—
♀	11·3	10·3	2·6	1·2	5·5	4·	—
♀	11·2	10·3	2·5	1·2	5·3	4·	—
Range	11–12·2	10·2–11·3	2·5–2·7	1·1–1·2	5·2–5·7	4·	·0–·1

A series of ten specimens were taken "from swampy ground" at Pundalu-oya in March by E. Ernest Green.

Acanthalobus, gen. nov.

Plate II., figs. 8–8*a*.

Related to *Criotettix*, Bolivar. Body more or less tuberculose, granulate or nodulose, or rugulose. Head not exserted or elevated: crown short. Eyes moderately prominent. Vertex wider than eye flattened, subfossulate on each side, middle feebly carinate, in front provided on each side with arcuate abbreviate margin; supra-ocular lobes at the lateral margin distinct. Frontal costa in profile advanced more or less before the eyes; face lightly retreating. Antennæ moderately short filiform, inserted between the lower portion of the eyes. Pronotum truncate in front, posteriorly extended backwards beyond the femoral knees long subulate or abbreviated; dorsum above flattened, between the shoulders more or less convex, behind the shoulders often bifossulate; median carina of pronotum slender scarcely elevated, sometimes interrupted; lateral carinæ posteriorly on the apical process often obsolete; posterior angle of lateral lobes laminate produced outwards, armed with an oblique spine. Elytra oblong-ovate; wings extended to or beyond the pronotal apex. Maxillary palpi elongate, very slightly compresso-ampliate. Femoral margins entire or lightly crenulate, the second femora rarely indistinctly sublobate or denticulate. First article of posterior tarsi little longer than the third.

Criotettix, Bolivar, in part.

Resembling *Criotettix* but differing from that genus in having larger stature; in the structure of the vertex; in the eyes being less globose and not at all exserted; the pronotum being broader between the shoulders; the absence or but slight evidence of a short supernumerary carinula on each side between the shoulders and also in the more pronounced rugose surface of the dorsum.

This genus embraces such species as *A. flavipictus*, Bol.; *A. miliarius*, Bol.; *A. bispinosus*, Dalm.; *A. saginatus*, Bol.; *A. m. cuneatus*, Hanc., &c.

Key to Species of Acanthalobus.

Pronotal process and wings long extended backward beyond the knees of hind femora. (Plate II., figs. 8–8*a*), *miliarius*, Bol.

Pronotal process and wings abbreviated; median carina of pronotum irregularly sinuate posteriorly; *miliarius cuneatus*, Hanc.

11.—*Acanthalobus miliarius*, Bol.

Plate II., figs. 8–8*a*.

Body medium robust, granulate, coarsely tuberculate or elongate callosed. Vertex viewed from above distinctly wider than one of the eyes, flattened, not advanced quite so far as the eyes, the front margin truncate but provided on each side with a small arcuate carinula, a little elevated at the sides and abbreviated; middle of vertex somewhat feebly carinate forwards, on either side subfossulate, the lateral margins divergent backwards, provided with distinct supra-ocular lobes; crown of head in profile scarcely elevated horizontal. Frontal costa little advanced before the eyes, lightly convex protuberant between the antennæ; profile of face slightly retreating; viewed in front the facial frontal costa narrowly sulcate above, the rami little divergent below. Eyes of moderate size subtriangular, not at all exserted. Antennæ short filiform, joints distinct, the first basal article large and longitudinally compressed. Pronotum truncate in front posteriorly long subulate extended backwards far beyond the posterior femoral knees, but not reaching quite so far as the wings; dorsum above flattened, between the shoulders transversely rounded, moderately broad, in front of the shoulders laterally little constricted fossulate, behind distinctly flattened; humeral angles widely obtuse; median carina distinct percurrent, little elevated, in profile irregularly convex forward, scarcely substraight posteriorly; anterior prozonal carinæ more or less distinct slightly convergent backwards; lateral carinæ distinct passing forwards on the shoulders, posteriorly on the apical process obliterated; infra scapular area above the elytra narrow subsulcate, scarcely at all arcuate, opposite the outer half of the elytra about as wide as the scapular area; lateral lobes posteriorly bisinuate behind, the posterior angle laminate outwards, provided with a distinct strong spine directed obliquely backwards, the posterior angle obliquely truncate behind. Elytra oblong ovate apex angulato-rounded; wings fully developed extended backwards little beyond the pronotal apex. Anterior femora entire elongate; middle femora elongate, marginal carinæ subindistinctly undulate; posterior femoral margins above crenulate, knee reduced; posterior tibiæ sinuate curvate, margins spinose, eight to ten on the outer side; first articles of posterior tarsi little longer than the third, pulvilli elongate flat below.

Blades of ovipositor slender denticulate. The males are generally smoother than the females on the dorsum of pronotum.

Measurement in Millimeters.

Sex.	Length of Body.	Pronot.	Shoulders.	Elytra.	Post. Fem.	Antennæ.	Wings + Pronot.
♀	19·5	18·2	4·	2·4	8·75	3·4	·4
♀	19·5	18·3	4·	2·5	8·6	3·5	·2
♀	19·	17·8	4·	2·4	8·6	—	·2
♀	19·	18·	4·	—	8·5	—	·2
♀	20·	18·5	3·9	2·3	8·2	3·5	·2
♀	20·	18·8	4·	2·5	8·3	—	·2
♀	20·	18·8	4·	2·5	9·	4·	·3
♀	20·	18·5	4·	2·5	8·5	3·8	·2
♀	19·8	18·8	4·	2·5	9·	3·8	·2
♀	19·	18·	4·	2·5	8·4	3·8	·8
♀	17·8	16·8	3·75	2·5	8·	3·75	·1
Range	17·8–20	16·8–18·8	3·75–4	2·3–2·5	8–9	3·4–3·8	·1–·8
♂	17·	16·	3·3	2·2	8·2	3·5	·5
♂	17·2	16·4	3·3	2·2	7·8	3·5	·0
♂	17·2	16·4	3·3	2·	7·9	3·2	·5
♂	17·3	16·2	3·4	2·2	8·	3·75	·3
♂	16·2	14·	3·2	2·	7·2	3·2	·2
♂	17·2	16·2	3·4	2·1	7·9	3·5	1·
♂	15·5	15·3	3·2	2·	7·	—	·2
♂	17·5	16·5	3·8	2·2	8·	—	·1
♂	15·	14·	3·	1·9	6 9	—	·2
♂	17·5	16·5	3·75	2·2	7·2	—	·5
♂	17·5	16·5	3·6	2·2	7·2	3·75	·5
♂	16·2	15·2	3·2	2·	7·2	3·5	·0
♂	17·2	16·2	3·4	2·1	7·3	3·5	·1
♂	16·	15·	3·2	2·	7·	3·5	·0
♂	17·2	16·2	3·4	2·	7·5	—	·2
Range	15–17·5	14·–16·5	3·–3·8	1·9–2·2	6·9–8·2	3·2–3·75	0–1·

Two females from Peradeniya "caught at light" in June, 1901. One male "on banks of river" at Kandy, June, 1903. Five males and three females and several nymphs from Kesbewa (Colombo), "from rice fields and dry bed of tank," April, 1903. Nine males and six females "caught at light," Colombo, in April. E. Ernest Green.

There is considerable variation in this species as shown in the table of measurements of twenty-six specimens.

Bolivar described the species from one male, the measurements of which are as follows :—

Length of body ♂, 11 mm., pronot. 16·5 mm., post. fem. 7 mm. *Criotettix miliarius*, Bol. (1887, p. 226).

12.—*Acanthalobus miliarius cuneatus*, form. nov.

Similar to *A. miliarius;* the form of the vertex and legs being the same, and in all other respects similar, with the exception of the pronotum and wings. The pronotum differs in being more rugose, and more cuneate posteriorly, the apex extending not more than two millimeters beyond the femoral knees, and not or little

passing the wings. The median carina of pronotum posteriorly irregularly sinuate. Wings more or less abbreviate.

Measurement in Millimeters.

Sex.	Length of Body.	Pronot.	Shoulders.	Elytra.	Post. Fem.	Antennæ.	Wings + Pronotum.
♀	16·5	15·5	4	2·4	9·2	3·75	·5
♀	16	15	4	2·2	8	3·75	·0
♂	12	11·5	3	1·5	6·5	3	·3

Two females and one male "from rice fields and dry bed of tank," Kesbewa (Colombo), April, 1903. E. Ernest Green.

This form resembles *Criotettix saginatus*, Bol. (1887, p. 280), and may prove to be synonymous.

Loxilobus, gen. nov.

Plate I., fig. 3.

Related to *Acanthalobus*, Hancock, but having the facial frontal costa roundly or convexly protuberant before the eyes; the vertex not appreciably flattened, nearly equal or narrower than one of the eyes and fossulate on each side; the body slender or of moderate width between the shoulders; the posterior angles of the lateral lobes not at all or very slightly laminate outwards, the posterior angles being suboblique, but somewhat narrowly excised behind, or acute subspiniform; the antegenicular lobe of posterior femora moderately conspicuous.

Key to Species of Loxilobus.

Body attenuate, pronotal process and wings long extended backward beyond the posterior femora; posterior angle of lateral lobes acute. (Plate I., fig. 3, and plate III., figs. 16–16*b*.)

acutus, sp. nov.

Body cuneate, pronotal process and wings abbreviated, not extended backwards so far as the apex of posterior femora; posterior angles of lateral lobes narrowly obliquely excised.

rugosus, sp. nov.

13.—*Loxilobus acutus*, sp. nov.

Plate I., fig. 3, and Plate III., figs. 16–16*b*.

Body slender tuberculose granulate. Vertex subequal or scarcely wider (in female) than one of the eyes, narrowed toward the front, middle carinate anteriorly and little elevated produced, on each side fossulate; front margin of vertex advanced nearly as far as the eyes, provided on either side with a small rounded abbreviated carinula, little elevated, supraocular lobes at the lateral

margins appreciably distinct; the crown of head viewed in profile barely elevated above the eyes. Facial frontal costa in profile roundly protuberant, advanced beyond the eyes equal to about one-third their diameter; the contour of face distinctly retreating; the frontal costa viewed from in front moderately sulcate, the rami subparallel. Eyes not exserted, of moderate size, subglobose; posterior ocelli distinct situated barely in advance of the middle of the eyes. Antennæ slender filiform, articles elongate, inserted between the lower third of the eyes. Pronotum truncate in front, posteriorly long attenuate extended beyond the knee of hind femora; dorsum rugose granulate, elongate tuberculose, between the shoulders transversely convex, provided with an abbreviated ruga on each side; anterior prozonal carinæ distinct, little convergent backwards; humeral angles wide, distinct; lateral carinæ little elevated; median carina subpercurrent but slightly subexcavate in front of the shoulders, posteriorly indistinctly sinuate; posterior angles of lateral lobes outwardly acute produced subspiniform, behind the angle subtransverse; infra scapular area above the distal half of elytra narrow sulcate subarcuate, about as wide as the scapular area. Elytra oblong ovate; wings well developed extended about one millimeter beyond the apex of pronotal process. First and second femoral margins entire, posterior femoral margins crenulate, antegenicular tooth subacute, distinct; lateral margins of posterior tibiæ crenulate, armed with spines, as many as ten in the outer margin; first article of posterior tarsi slightly longer than the third, the third pulvillus longest flat below. Superior blade of ovipositor rather stout, strongly denticulate.

Measurement in Millimeters.

Sex.	Length of Body.	Pronot.	Shoulders.	Elytra.	Post. Fem.	Antennæ.	Wings and Pronotum.
♀	15·8	13·8	2·9	2·	6·2	3·9	1·

One female "caught at light," Pundalu-oya, May, 1903. E. Ernest Green.

14.—*Loxilobus rugosus*, sp. nov.

Plate III., figs. 17–17*b*.

Body small, rugose tuberculose granulate. Vertex and facial frontal costa similar in structure to *acutus* as shown in figures 17–17*b* compared with figures 16–16*b*. In the male the crown of the head viewed in profile is scarcely so elevated above the eyes. This species differs from *acutus* in being smaller in stature, but about the same width between the shoulders; the pronotal process and wings abbreviated not extended backward so far as the apex of

posterior femora; the surface of the dorsum, especially in the female, more rugose; the median carina of pronotum viewed in profile distinctly sinuate; the posterior angle of the lateral lobes of pronotum narrowly obliquely excised, not at all acute spiniform.

Measurements.

Sex.	Length of Body.	Pronotum.	Width of Shoulders.	Elytra.	Post. Fem.	Antennæ.	Pronot. and Wings.
♀	10·2	9·2	3·	1·5	6·2	3·9	·5
♀	·7·5	6·6	2·9	1·1	6·3	3·75	·2
♀	9·2	8 2	3·	1·3	5·8	3·8	W +·2
♂	7·4	6·8	2·5	1·1	5·1	3·2	·0
♂	8·	7·	2·5	1·1	5·	—	·5
♂	7·5	6·5	2 5	1·	4·9	3·2	·2

One female and two males "swept from grass land," Pundaluoya, in March; two females and a male "swept from grass fields," Pundalu-oya, in May, 1903. Three nymphs from "swampy ground," March. E. Ernest Green.

This species resembles *Criotettix pullus*, Bolivar. I have compared it with a male *pullus* kindly contributed to my collection by Professor Bolivar. It differs from that species in the frontal facial costa being more roundly protuberant before the eyes, and in the dorsal surface of the pronotum being more coarsely rugose.

Criotettix pullus, Bol. (1887, p. 230), undoubtedly falls into the newly created genus *Loxilobus*, as do several other related species from other parts of the world.

III.—Subtribe *METRODORINÆ*.

Gen. *Systolederus*, Bol.

Plate II., figs. 9-9*b*.

Head exserted, elevated forward. Vertex less than half the breadth of one of the eyes, toward the front narrowed and subacuminate. Eyes approximate strongly globose. Face oblique, the contour sinuate; frontal costa scarcely furcillate behind the ocelli, very lightly sulcate, viewed in profile compresso-elevated between the antennæ. Antennæ inserted below or barely between the lower part of the eyes scarcely in advance of them, filiform, articles elongate, palpi filiform. Pronotum flattened above, in front truncate, posteriorly acuminate; median carina inconspicuous disappearing just behind the anterior border; humeral angles obtuse; posterior angles of lateral lobes extended outwards very frequently acute spinose or downward deflexed. Elytra oval; wings perfectly explicate.

Legs elongate filiform; anterior femoral carinæ minutely granulate; genicular as well as the femoral lobes of the posterior

femora small ; posterior tibiæ toward the apex little ampliate, margins compressed, spinose ; first and third articles of posterior tarsi subequal in length. *Systolederus*, Bolivar (1887, p. 234).

15.—*Systolederus greeni*, Bol.

Plate II., figs. 9-9*b*.

Fusco-cinereous. Vertex very narrow, short carinated ; ocelli strongly exserted. Antennæ inserted scarcely before the eyes. Pronotum granulate, in front of the shoulders lightly constricted, anterior margin subreflexed, sulci strongly impressed, disc between the shoulders convex, behind distinctly transversely fossulate, median carina not very conspicuous, viewed from the side undulate, between the sulci transversely compressed ; anterior prozonal carinæ obsolete ; lateral lobes deflexed acute but not at all produced, process long subulate, apex shortly bispined. Wings extended to the pronotal apex. Legs pale variegated, not at all or indistinctly undulate ; posterior femoral carinæ acute, minutely serrulato-crenulate, minutely spined, rarely little distinct, very frequently absent on the internal margin. The third pulvilli of the posterior tarsi scarcely twice as long as the second.

Systolederus greeni, Bol. (1902, p. 584).

Bolivar gives the following dimensions : Length of body ♂, 7 mm. pronot. 11 mm. ; post. fem. 5 mm. ♀, 9 mm. ; pronot. 14 mm. ; post. fem. 6·5 mm.

According to these measurements the female type specimen was slightly larger than the maximum size in the following table :—

Measurements in Millimeters.

Sex.	Length of Body.	Pronot.	Width of Shoulders.	Elytra.	Post. Fem.	Antennæ.	Wings+ Pronot.
♂	11·9	11·	2·6	1·1	5·	3·	·2
♂	11·9	10·8	2·7	1·2	5·	3·	·0
♂	11·4	10·5	2·5	1·2	5·	3·	wings-·3
♂	11·9	10·8	2·5	1·2	5·	3·	·0
♂	11·8	10·8	2·7	1·1	5·	3·	·0
♂	11·9	10·9	2·7	1·2	5·1	3·	·1
♂	12·	11·	2·6	1·2	5·	3·	·0
♂	12·	11·	2·7	1·2	5·	3·	·0
♂	11·9	10·9	2·6	1·2	5·	3·1	wings-·2
Range	11·4–12	10·5–11	2·5–2·7	1·1–1·2	5·–5·1	3·–3·1	–·3–+·2
♀	14·1	13·	3·	1·5	6·1	3·5	·0
♀	13·	11·9	2·9	1·3	5·6	3·	·1
♀	13·4	12·	2·9	1·4	6·	3·1	·1
♀	13·9	12·9	3·	1·3	6·	3·2	·0
♀	13·5	12·7	3·	1·3	5·6	3·2	·0
♀	13·2	12·1	3·	1·3	5·9	3·5	·1
♀	14·	12·9	3·1	1·5	6·	3·2	·2
♀	14·	13·	3·	1·3	6·	3·75	·0
♀	12·9	12·	3·	1·2	6·	3·2	·0
Range	12·9–14·1	11·9–13	2·9–3·1	1·2–1·5	5·6–6·1	3·–3·75	0–·2

Of eighteen specimens referable to this species six females and nine males from Pundalu-oya were taken in March "frequenting hot dry rocks away from water ; very active on the wing ; living specimens minutely pale speckled."

Three females from Kadugannawa, taken in January, were "from dry rocks on side of railway." E. Ernest Green.

Bolivar records the species from Kodiakanal, South India, and Pundalu-oya, Ceylon.

This species is distinguished by the approximate elevated eyes which are subflattened but strongly globose in profile ; by the exserted ocelli ; by the position of the antennæ which are inserted below the eyes, and the angulate excavation below the median ocellus visible in profile.

Genus *Mazarredia*, Bol.

Plate II., figs. 7–7*b*.

Head little or very slightly exserted. Vertex little narrower than one of the eyes, or subwider, very frequently narrowed forward, on either side with oblique carinula more or less compressed ; face little oblique. Frontal costa scarcely forked behind the ocelli ; the rami little divergent forward, viewed in profile shortly compresso-elevated between the antennæ, frontal contour appreciably sinuate. Antennæ filiform often strongly elongate, inserted little before the eyes ; posterior ocelli situated scarcely before the middle of the eyes ; apical article of maxillary palpi narrow subcompressed. Pronotum above flattened between the shoulders, often gibbose, in front truncate, posteriorly lengthily acuminate, humeral angles obtuse ; posterior angles of lateral lobes outwardly more or less laminato-expanded, strongly truncate, acute angulate but not at all spinose, very rarely turned downward. Elytra oval ; wings perfectly explicate. Legs elongate ; anterior femora very slightly compressed, above carinate, carinæ entire or gently undulate ; posterior tibiæ little enlarged towards the apex, on either side spinose ; the first and third articles of the posterior tarsi equal in length.

Mazarredia, Bolivar (1887, pp. 236–237).

16.—*Mazarredia insularis*, Bol.

Plate II., figs. 7–7*b*.

Body small rugulose. Head very little exserted ; face slightly retreating. Eyes of moderate size distinctly globose, being little higher than the dorsum of pronotum. Vertex viewed from above slightly wider than one of the eyes, the front margin subconvexly truncate but viewed in front strongly concave, the frontal carinulæ laterally elevated on each side, acute cuspidate, in

profile little higher than the eyes; on either side of vertex fossulate, posteriorly mammillate, mid-carina appreciably reduced forward, but distinctly produced. Facial frontal costa viewed in profile not at all or barely advanced so far as the eyes, between the antennæ lightly convex, very feebly excavate just below the median ocellus. Antennæ fuscous, slender filiform, articles elongate, pale annulate at their junctions, inserted somewhat below the eyes. Pronotum flattened rugulose, truncate in front, posteriorly extended beyond the hind femora, between the shoulders provided with a short elevated carinula on each side; lateral carinæ distinct, just behind the shoulders eminently elevated; median carina of pronotum little compressed anteriorly just before the shoulders and between them slightly elevated cristulate sinuate, posteriorly irregularly lightly sinuate, infra scapular area, moderately narrow subflattened; scapular area small obscure; posterior angle of lateral lobes of pronotum outwardly laminate produced subacute, behind obliquely and moderately but widely truncate. Elytra elongate, apex rounded; wings extended backward to the apex of pronotal process. Anterior femora distinctly compressed, marginal carinæ undulate; middle femora lightly compressed, carinate externally, marginal carinæ undulate; posterior femora rather stout but flattened elongate, margins crenulate; tibial margins of posterior femora crenulate, outer carina furnished with from three to five spines, or sometimes absent, inner carina with one or two obsolete spines or absent; third pulvilli of posterior tarsi scarcely longer than the first and second subacute.

Colour grayish ferrugineous, sometimes slightly marked with fuscous on the dorsum of pronotum.

Mazarredia insularis, Bolivar (1887, p. 239).

Measurements in Millimeters.

Sex.	Length of Body	Pronot.	Width of Shoulders.	Elytra.	Post. Fem.	Antennæ.	Wings — Pronot.
♂	10·3	9·7	2·6	1·	5·1	3·9	—·1
♂	9·	9·	2·5	1·	4·5	4·	—·1
♂	11·	10·	2·9	1·	5·	4·	·0
♀	11·	10·	3·	1·2	5·5	4·	·0
♀	11·8	11·	3·	1·2	6·	4·	·0
♀	11·5	10·3	3·1	1·2	5·9	4·1	—·1
♀	12·	11·	3·	1·2	6·	4·	·0

Seven adult specimens. Three males, three females, and three nymphs from Pundalu-oya were collected "from stems of Grevillea tree" in May. The remaining adult male from Hantanne

was taken in March. Mr. Green remarks that the living insects are often coloured like and harmonize with the natural lichens and mosses, being very inconspicuous. Bolivar described the species from a male example which measured as follows :—

Length of body 7 mm.; pronot. 10 mm.; post. fem. 5 mm. (Ceylon).

Apterotettix, gen. nov.

Plate III., figs. 13–13*a*.

Body rugulose granulate. Face moderately oblique; facial frontal costa distinctly advanced before the eyes, not at all sinuate, united with the crown angulate in profile. Vertex subequal in width to one of the eyes, very slightly convergent forward, the front margin advanced beyond the eyes, provided with abbreviated arcuate carinula on each side, little elevated laterally middle carinate, produced: viewed in front or in profile the vertex not lower than the eyes. Eyes of moderate size not appreciably prominent or elevated. Antennæ inserted a little in advance of the lower fourth of eyes, slender filiform. Pronotum truncate in front posteriorly abbreviated not extended backward so far as the extremity of the abdomen; dorsum between the shoulders subtectiform; humeral angles obtuse; scapular area moderately wide attenuate posteriorly; posterior angle of lateral lobes outwardly little produced, behind obliquely truncate. Elytra and wings absent or vestigial. Femora lightly compressed, first and second marginal carinæ entire or subundulate; posterior femoral margins serrulate, femoral and genicular lobes moderately prominent, acute; lateral margins of posterior tibiæ serrulate spinose; first and third articles of posterior tarsi subequal in length.

17.—*Apterotettix obtusus*, sp. nov.

Plate III., figs. 13–13*a*.

Body small, rugulose granulate. Head not at all exserted; face moderately retreating. Vertex subequal in width to one of the eyes, the front border convex, advanced slightly beyond the eyes, frontal carina on each side laterally arcuate abbreviated, barely elevated, mid-carina viewed in profile, in female, little elevated in front and produced; viewed in front the vertex hardly lower than eyes subtransverse. Facial frontal costa viewed in profile distinctly advanced before the eyes substraight, united with the vertex angulate, viewed in front moderately sulcate. Eyes of moderate size globose, not appreciably prominent. Antennæ moderately long, very slender filiform articles elongate, inserted between the lower fourth of the eyes. Posterior ocelli in profile visible just before the middle of the eyes. Pronotum subflattened above, transversely between the shoulders subtectiform, in front

truncate, posteriorly abbreviated, apex obtuse, not extended so far backwards as the abdomen ; humeral angles obtuse ; dorsum between the shoulders provided with a short supernumerary carinula on each side ; prozonal carinæ little converging backward ; median carina of pronotum substraight or scarcely undulate ; infra scapular area moderately wide, posteriorly little widened acuminate ; posterior angle of lateral lobe outwardly slightly extended, behind obliquely truncate. Elytra and wings absent or vestigial. Anterior and middle femora slightly compressed, in the male the second femora ampliate, marginal carinæ entire or subundulate ; posterior femoral and genicular lobes moderately prominent acute, marginal carinæ minutely serrulate ; posterior tibial carinæ of hind femora laterally serrulate, spinose ; the first and third articles of posterior tarsi subequal in length, the second and third pulvilli elongate, subequal in length, but little longer than the first article.

Measurements in Millimeters.

Sex.	Length of Body.	Pronot.	Width of Shoulders.	Post. Fem.	Antennæ.
♂	6·4	5·	2·4	4·6	3·2
♂	6·4	5·1	2·4	4·6	3·2
♂	6·1	4·8	2·4	4·5	3·2
♂	6·4	5·	2·5	4·7	3·2
♀	9·	6·3	2·9	5·7	3·8
♀	7·5	5·4	2·7	5·	3·5
♀	8·7	5·9	2·9	5·1	3·5
♀	8·5	6·	2·8	lost	3·7

Eight specimens. A female from Peradeniya, taken in December, 1902, "from grass land"; two females from the same locality caught in February and March. One female from Pundalu-oya was "swept from a grassy ravine" in May ; while from the same locality three males were found "among fallen leaves under shade of trees" in May. Still another male was "swept from grass fields" in March from the same locality.

This small apterous species is easily distinguished by the structure of the vertex and frontal costa. It is monotypic and appears to be confined to Ceylon.

IV.—Subtribe *TETTIGINÆ*.

Gen. *Tettix*, Charp., 1841.

Plate III., figs. 14–14*b*.

Body granulate or little rugose. Head not at all exserted. Vertex wider or rarely subnarrower than one of the eyes, laterally more or less sinuate, front carinate subangulato-rounded, viewed

in profile subacute before the eyes distinctly produced. Frontal costa behind the antennæ very frequently sinuate. Antennæ very short, not at all reaching the humeral angles, often shorter than the head, a little enlarged, consisting of twelve to fourteen articles, inserted scarcely before the eyes. Pronotum truncate in front or angulate, posteriorly acute very frequently abbreviated, dorsum above tectiform rarely depressed, between the shoulders a little ampliate ; humeral angles strongly obtuse ; posterior angle of the lateral lobes slightly turned obliquely outwards, inferior lateral margin straight or base subsinuate. Femora entire or rarely femoral carinæ subsinuate ; posterior tibiæ linear, slender, but ampliate near the apices, carinæ serrulate, short spinose or the apical fifth of the inner carina unarmed ; first article of the posterior tarsi elongate, distinctly longer than the third.

Tettix, Charp. (1841, p. 315), Fischer, Bolivar, Brunner, Hancock.

Tettix, Latreille, Hist. Nat. d. Crust. Ins., XII., 161–164.

Equivalent to *Acrydium* of some authors.

Key to Species of Tettix.

Pronotum and wings more or less abbreviated.

atypicalis ceylonus, form. nov.

Pronotum posteriorly long subulate, wings caudate. (Plate III., figs. 14–14*b*.)

atypicalis, sp. nov.

18.—*Tettix atypicalis*, sp. nov.

Plate III., figs. 14–14*b*.

Body slender, granulate punctate. Vertex viewed from above equal in width to one of the eyes, front margin subtruncate, advanced about as far or scarcely beyond the eyes, carinulæ arcuate abbreviated, very slightly elevated laterally, side margins very little convergent forward, middle carinate produced in front, on either side little longitudinally depressed ; vertex viewed in profile advanced before the eyes. Frontal costa viewed in profile convex behind the antennæ, viewed in front moderately sulcate, the rami slightly diverging toward the base ; face sensibly retreating. Eyes small globose barely exserted. Antennæ rather short, slender filiform. Pronotum truncate in front obtuse subangulate, posteriorly long subulate acute strongly extended beyond the apex of posterior femora ; dorsum between the shoulders tectiform ; humeral angles widely obtuse ; median carina of pronotum elevated acute compressed, percurrent, anteriorly longitudinally

arcuate, posteriorly subconcave; elytral sinus shallow; the inferior sinus deeply angularly excavate; the posterior angle of lateral lobes with the apex moderately wide rounded-truncate. Elytra oval apex rounded; wings caudate, extended strongly beyond the apical process. Femora slightly compressed; anterior and middle femoral margins entire or indistinctly undulate, finely crenulate or serrulate; posterior femoral margins serrulate; posterior tibiæ undulato-curvate, lateral margins subserrulate spinose; first and third articles of posterior tarsi subequal in length, the third pulvillus as long as the first and second together, the apices spiculate. Margins of legs, the mouth parts and under parts of body hirsute. Ovipositor short, the superior blade being unusually wide as compared to the length. Colour grayish or ferrugineous with fuscous macula on each side of the dorsum behind the shoulders, legs annulated with fuscous.

Measurements in Millimeters.

Sex.	Length of Body.	Pronot.	Width of Shoulders.	Elytra.	Post. Fem.	Antennæ.	Wings and Pronotum.
♀	14·0	10·5	2·7	1·5	5·	3·2	2·5
♀	12·9	9·9	2·5	1·5	5·	—	2·
♀	11·5	9·	2·6	1·7	5·	—	1·3

Three females. One bearing the locality (Kandy) measures the longest in the series and was taken "from grass land in November, 1903." The second example from Peradeniya was "caught at light" in July, 1903, being also a long-wing form. The third specimen from Dikoya was taken in February, 1903, "from grass land." The last mentioned specimen is a variety having the pronotum anteriorly more strongly compresso-elevated between and before the shoulders, the median carina of pronotum more elevated cristate. These peculiarities are correlated with shortened wings and abbreviated pronotal process; the latter not being extended quite so far backwards beyond the posterior femoral knees. This species being dimorphic passes into the next form, some examples of which are very much reduced in size.

19.—*Tettix atypicalis ceylonus*, form. nov.

Related to the preceding *T. atypicalis*, but having the vertex slightly more advanced as viewed from above; the pronotum and wings more or less abbreviated; the antero-dorsal margin of pronotum obtuse angulate; the body often very diminutive in stature; the middle femora in the male distinctly expanded.

Measurements in Millimeters.

Sex.	Length of Body.	Pronot	Width of Shoulders.	Elytra.	Post Fem.	Antennæ.	Wings or+ Pronotum.	Pronotum— or+ H. F.
♂	7·	6·3	2·2	1·	4·3	3·	+ ·1	0
♂	7·5	6·9	2·3	1·	4·3	3·1	+ ·1	+ ·7
♂	6·9	6·	2·2	1·	4·2		·2	— ·2
♀	10·	7·3	2·5	1·2	4·9	3·4	+ 1·4	0
♀	7·8	6·8	2·5	1·2	5·	3·5	+ ·5	— ·5
♀	7·2	6·3	2·3	1·2	5·	—	+ ·2	— ·3
♀	8·1	7·5	2·3	1·2	5·	—	—	0

Seven specimens. One female from Maskeliya taken in August, 1902, "caught at light." Of the remaining six specimens from Pundalu-oya, four were "swept from grass fields" in March and April.

A male and female of this series taken in January at Pundalu-oya were contributed to my collection by Malcolm Burr. For the other five specimens I am indebted to E. Ernest Green.

Gen. *Paratettix*, Bolivar.

Body granose, little rugose. Vertex horizontal, narrower than the eyes or equally wide, middle carinate, on either side more or less concave or lengthwise canaliculate, anterior carinulæ terminating in flexures, viewed in profile not at all produced between the eyes. Frontal costa between the antennæ curved, declined toward the base, rarely subsinuate. Antennæ filiform, little longer than the head, composed of fourteen articles inserted barely before the eyes; palpi not dilated, same colour as the body. Pronotum with the dorsum rather flattened, front border truncate, posteriorly subulate, very frequently the apex passing the hind femora, but sometimes abbreviated; median carina a little elevated; humeral angles obtuse; lateral lobes posteriorly bisinuate, the inferior sinus straight or acute, posterior angle of lateral lobe turned downward, apex subrounded. Elytra oval punctate; wings perfectly explicate, very rarely abbreviated. Anterior femora compressed, above carinated, very frequently undulate; posterior tibiæ with the apical third part ampliate, as well as spinose; first articles of posterior tarsi elongate, longer than the third, pulvilli acuminate, below straight, the third pulvillus very frequently longer than the first and second united.

Paratettix, Bolivar (1887, p. 270).

20.—*Paratettix variegatus*, Bol.

Grayish, variegated with white and fuscous, or ferrugineous. Head little exserted. Vertex elevated forward, truncate in front, equal in width to eye. Frontal costa obliquely declivous toward

the base. Pronotum posteriorly subulate; dorsum tectiform, rugulose punctate, marked with whitish and fuscous; median carina elevated, compressed, anteriorly regularly arcuate; posterior angles of lateral lobes with the apices narrow rounded truncate, external margin turned outwardly subreflexed. Elytral apex widely rounded; wings long extended backward beyond the apical process. Anterior femoral carinæ obscure undulate; posterior femora above crenulate, before the apex with minute lobe; posterior tarsal pulvilli with apices acute, third pulvillus longer than the second.

Length of body ♂♀, 7–7·5 mm.; pronot. 9–9·5 mm.; post. fem. 5–6 mm.

Locality, Ceylon (Bolivar).

Paratettix variegatus, Bol. (1887, p. 280).

I have not seen specimens of this species in nature.

Euparatettix, gen. nov.

Plate II., figs. 10–10*b*.

Related to *Paratettix*, Bolivar, but having the head somewhat compresso-elevated exserted; eyes strongly globose; the vertex narrower than eye and elevated forward; the frontal costa more or less convex or arcuate produced, declivous toward the base; the dorsum of pronotum subflattened, the antero-dorsal margin not advanced to the eyes; with moderately long antennæ, the last five articles often little compresso-ampliate, inserted barely below or on a level with the inferior border of the eyes; the anterior femora slender entire or nearly so.

To this genus belong such species as *Paratettix personatus*, Bol., *Paratettix interruptus*, Brunn, *Euparatettix parvus*, Hanc.

KEY TO SPECIES OF EUPARATETTIX.

Frontal costa flattened between the eyes, lightly convex between the antennæ; antennæ rather short, the distal five articles hardly compresso-ampliate. Body small; *parvus*, Hanc.

Frontal costa strongly arcuate produced entire; antennæ rather long the distal five articles perceptibly compresso-ampliate (plate II., figs. 10–10*b*, and plate III., figs. 20–20*b*), *personatus*, Bol.

21.—*Euparatettix parvus*, sp. nov.

Body small, slender rugulose. Head exserted, perceptibly compresso-elevated. Vertex viewed from above narrower than one of the eyes, advanced about as far as the eyes, viewed in profile not at all produced, the front margin laterally with elevated abbreviated carinula on each side, middle carinate. Frontal costa lightly convex between the antennæ, obliquely declivous

toward the base, viewed from in front moderately sulcate or not so narrowly sulcate as in *personatus*. Eyes strongly globose elevated, higher than the pronotum. Antennæ slender filiform, of moderate length, very little compresso-ampliate apically, inserted barely below the lower border of the eyes. Pronotum in front truncate, the antero-dorsal margin not advanced to the eyes, posteriorly subulate, above subflattened rugulose, between the shoulders with fine indistinct abbreviated supernumerary carinulæ on each side; median carina subsinuate little elevated, subflattened between the shoulders, excavate just behind the anterior margin, behind the shoulders posteriorly indistinctly sinuate; anterior prozonal carinæ small abbreviated; lateral carinæ in front of humeral angles distinct; infra-scapular area above the elytra very narrow, little widened posteriorly behind the apex of elytra; posterior angle of the lateral lobes of pronotum turned downwards, subrounded truncate. Elytra oval apex rounded; wings long, extended backward beyond the apex of pronotal process. Anterior femora very slightly compressed, entire; middle femora little compresso-ampliate, entire, the breadth contained about two and a half times in the length; posterior femoral margin above serrulate, external pagina scabrous, two of the oblique lines behind the middle little outwardly protuberant; posterior tibiæ spinose, fuscous with two light annulations; first and third articles of posterior tarsi nearly equal in length, the pulvilli acute spiculate, the third little exceeding the second in length.

One male specimen from Elephant Pass, Northern Province, Ceylon. March, 1901. E. Ernest Green.

Length of body ♂, 9·7 mm.; pronot. 8 mm.; width of shoulders 2 mm.; elytra 1 mm.; post. fem. 3·9 mm.; antennæ 3 mm.; wings + pronot. 1 mm.; pronot. + fem. 2 mm.

The exserted compresso-elevated head in this species, as in the one following, reminds us somewhat of *Systolederus*, yet *Euparatettix* bears a closer affinity to *Paratettix* in other characters.

22.—*Euparatettix personatus*, Bol.

Plate II., figs. 10–10*b*, and Plate III., figs. 20–20*b*.

Body finely rugose, fuscous, front of head, sides of pronotum cinereous. Head exserted, vertex elevated forward, narrower than eye. Frontal costa strongly arcuate produced, declivous toward the base, entire. Pronotum narrow, posteriorly subulate much surpassing the femoral apex; dorsum rugulose; median carina percurrent, little compressed, between the shoulders sinuate; posterior angle of the lateral lobe narrow rounded. Elytra with the apex not at all acuminate; wings strongly longer than the

pronotal process. Anterior femora narrow, carinæ subentire; posterior tarsal pulvilli below straight, the third pulvillus little longer than the second.

Length of body ♂♀, 6–8 mm.; pronot. 7·5–9·5 mm.; posterior fem. 4–6 mm.

Locality, Ceylon (Bolivar). It is also reported from Java and the Philippines.

Paratettix personatus, Bolivar (1887, p. 278).

The following series of fifteen specimens referable to this species are given in two separate series of measurements selected from different localities. This is done with a view of giving more concisely the range of variations occurring in the species. There are some marked structural variations in individuals difficult of measurement. For instance, two females taken at random, one from Kesbewa and the other from Peradeniya, show in the first-named specimen, the median carina of the pronotum beginning from just behind the front border backwards to the apical process, a succession of five distinct undulations, diminishing in size backward. While in the second specimen from Peradeniya, the median carina of pronotum is elevated but straight above between the shoulders and very indistinctly undulate backward. In the latter specimen the head is not so distinctly exserted, yet both forms are doubtless varieties of the same species, for there are some individuals presenting intermediate stages connecting the two types of individual peculiarities. The antennæ of the males are unusually long in this species, having the distal five articles appreciably compresso-ampliate. The hind tibiæ of both sexes are usually black or fuscous with a light annulation near the knees.

FIRST SERIES.

Measurements in Millimeters.

Sex.	Length of Body.	Pronot.	Width of Shoulders.	Elytra.	Post. Fem.	Antennæ.	Wings+ Pronotum.	Pronotum and Post.Fem.
♂	11·2	8·6	2·2	—	4·1	4.	+2·	—
♂	11·9	9·	2·2	—	4·	4·2	+2·1	+2·5
♂	1·5	9·	2·2	1·2	4·2	4·	+2·	+2·5
♂	12·	9·	2·3	1·5	4·5	4·1	+2·1	+2·4
Range	11·2–12	8·6–9	2·2–2·3	1·2–1·5	4–4·5	4·–4·2	+2·–2·1	+2·4–2·5
♀	13·2	10·2	2·9	1·5	5·	—	+2·2	+3
♀	13·9	10·7	2·9	1·8	5·	4·	+2·3	+2·8
♀	12·5	9·9	2·6	1·5	5·	4·	+2·3	+2·6
♀	13·5	10·5	2·9	1·8	5·	4·	+2·4	+2·5
Range	12·5–13·9	9·9–10·7	2·6–2·9	1·5–1·8	5·	4·	+2·2-2·4	+2·5–3·

The above series of eight specimens were "caught at light" at Colombo in April by Mr. Green.

SECOND SERIES.

Sex.	Length of Body.	Pronot.	Width of Shoulders.	Elytra.	Post. Fem.	Antennæ.	Wings+ Pronotum.	Pronotum and Post.Fem.
♂	11·	8·5	2·2	1·1	4·	3·7	+1·9	+2·
♂	11·3	8·9	2·3	1·2	4·3	4·	+1·7	—
♂	11·4	8·1	2·3	1·2	4·2	—	+2·	+2·
♂	11·3	8·1	2·2	1·2	4·	—	+2·4	+2·
	11· –11·4	8·1–8·9	2·2–2·3	1·1–1·2	4·–43	3·7–4·	+1·7–2·4	+2·
♀	13·2	10·8	2·9	1·6	5·	4·2	+2·	—
♀	13·3	10·	2·9	1·5	5·	4·1	+2·5	+2·4
♀	13·2	10·1	2·9	1·5	5·	4·2	+2·5	+2·5
	13·2–13·3	10·1–10·8	2·9	1·5–1·6	5·	4·1–4·2	+2·–2 5	+2·4–2·5

This series of seven specimens were also "caught at light" at Peradeniya: three in November, two in April, one in March, and the last one in June.

Besides the above series three females and two males bearing locality Kesbewa (Colombo) were taken in April. Mr. Green mentions that they were from rice fields and dry bed of tank. "The living examples being very variable in colour; sometimes with broad longitudinal stripe of emerald green." I think this note regarding the colour refers to *Hedotettix* which were found associated in the same environment. A single male labelled Jaffna, March, 1901, "from grass land," and lastly another male, is from North-Central Province, November.

Gen. *Hedotettix*, Bol., 1887.

Plate III., fig. 18.

Body nearly smooth, to a certain degree minutely granulate, or punctate impressed. Head little exserted. Vertex subhorizontal not at all wider than eye, middle carinate, towards the front very frequently distinctly ampliate, in front transversely carinate. Frontal costa between the antennæ arcuate produced, between the eyes not at all sinuate. Antennæ filiform nearly reaching to the humeral angles, inserted between the eyes. Pronotum truncate in front or obtuse angulate, posteriorly acute subulate, median carina slightly compressed, percurrent; posterior angle of lateral lobes very narrowly rounded-truncate, or subacute. Elytra apically rounded, rarely subacuminate. Wings the length of process or caudate, rarely abbreviated. Legs compressed, anterior femoral carinæ entire, or obscure undulate; posterior femoral carinæ granulate; posterior tibiæ slightly spinose; first article of posterior tarsi elongate, the third article shorter than the first.

Hedotettix, Bolivar (1887, p. 283).

KEY TO SPECIES OF HEDOTETTIX.

A.—Facial frontal costa widely sulcate, the rami more or less abruptly widened between the eyes; crown of head in profile distinctly elevated above the eyes.

gracilis, de Hann.

B.—Pronotum and wings abbreviated, median carina of pronotum sloping backward.

gracilis abortus, Hanc.

AA.—Facial frontal costa moderately or narrowly sulcate, not abruptly widened between the eyes; crown of head not at all or barely elevated above the eyes; antero-dorsal margin of pronotum truncate.

attenuatus, Hanc.

23.—*Hedotettix gracilis*, De Hann.

Plate III., figs. 19-19*a*.

Body moderately slender somewhat smooth, finely rugulose granulate. Crown of head convex, little elevated above the eyes forming with the frontal costa a rounded profile. Vertex viewed from above scarcely wider than one of the eyes in female or subequal in male, front margin obtuse angulate, barely advanced beyond the eyes, laterally the carinulæ rounded abbreviate, side margins strongly sinuate, middle carinate, distinctly produced. Frontal costa strongly rounded, advanced before the eyes equal to about one-third their diameter, viewed in front widely sulcate, the rami rather suddenly widened between the eyes and little narrowed below the point of insertion of the antennæ. Posterior ocelli conspicuous just in advance and barely above the middle of the eyes; eyes in profile subconoid globose. Antennæ rather short filiform, inserted scarcely above the level of the lower margin of eyes. Pronotum with the antero-dorsal margin obtuse angulate posteriorly more or less long acute subulate, passing the posterior femoral knees; dorsum between the shoulders elevated tectiform; between the sulci anteriorly little compressed; humeral angles obtuse; median carina of pronotum percurrent little compresso-elevated, longitudinally arcuate anteriorly, straight posteriorly; between the shoulders provided with thin indistinct abbreviated rugula on each side; anterior prozonal carinæ distinct, straight; infra-scapular area above the elytra long narrow sulcate, the scapular area indistinctly present; superior or elytral sinus of lateral lobes moderately deep; the inferior sinus deeply angularly incised; posterior angle turned downward subacute, the margin very slightly outwardly elevated. Elytra oblong, the apical margin rounded; wings fully developed, passing backward beyond the

pronotal process. Anterior femora slender entire; middle femora elongate externally distinctly bicarinate in the female, ampliato-expanded in the male, the superior carina convexo-subsinuate; posterior femoral margins crenulate, the antegenicular lobe small acute, knees moderately small; posterior tibiæ somewhat curvate spinose about two-thirds of the margins distad; the first articles of posterior tarsi nearly twice the length of the third, the first and second pulvilli acute, subspiculate, the third much longer than the second and straight below.

Colour plain ferrugineous; or fusco-ferrugineous, with the first and second legs annulated with white; or body plain fulvous; or the dorsum marked by broad longitudinal pale yellowish stripe, a little darkened toward the front, with black on each side between the shoulders, being interrupted by oblique white line passing from the middle stripe outward to the humeral angle on each side; the posterior tibiæ white.

Measurements in Millimeters.

Long-wing forms.

Sex.	Length of Body.	Pronot.	Width of Shoulders.	Elytra.	Post. Fem.	Antennæ	Wings + Pronot.	Pronot and H. F.
♂	14·3	11·1	2·5	1·7	5·6	3·4	+ 2·	+ 2·5
♂	13·1	10·5	2·5	1·6	5·6	3·3	+ 1·6	—
♂	13·	10·3	2·4	1·5	5·	3·3	+ 1·9	+ 2·4
♂	12·8	10·2	2·4	1·6	5·	3·1	+ 1·8	+ 2·5
♂	12·	9·	2·4	1·3	4·9	3·1	+ 2·	+ 1·7
♂	12·9	10·2	2·5	1·6	5·3	3·2	+ 1·9	+ 2·
♂	12·8	9·4	2·4	1·5	5·	—	+ 2·	+ 2·3
	12–14·3	9–11·1	2·4–2·5	1·3–1·7	4·9–5·6	3·1–3·4	+ 1·6-2	+ 1·7-2·5
♀	14·8	11·3	3·	1·9	6·	3·6	+ 2·	—
♀	14·9	11·	3·	1·9	5·9	3·5	+ 3·	—
♀	13·9	11·1	2·9	1·8	5·6	3·4	+ 1·9	—
♀	15·2	12·2	2·9	1·9	6·	3·4	+ 2·4	+ 3·1
♀	12·	9·7	2·8	1·6	5·8	3·4	·8	+ 1·2
	12–15·2	9·7–12·2	2·8–3	1·6–1·9	5·6–6	3·4–3·6	+ ·8–3	+ 1·2–3·1

The above series of twelve long-wing specimens typify the description, though as seen in the measurements there is considerable variation, especially with regard to the pronotum and wings. Three males and four males from Peradeniya "caught at light" during the months of March, April, May, October, and November from 1900–1903. One male caught at light, Dambulla, November, one male, Kesbewa (Colombo), April, "from rice field and dry bed of tank." One male "caught at light," Colombo, April. One male "from margin of tank," Kandy, November. E. Ernest Green.

Acridium (Tetrix) *gracile*, De Hann. (1842, p. 169).
Hedotettix gracilis, Bolivar (1887, p. 284).
Hedotettix festivus, Bol. (1887, p. 286).
Hedotettix gracilis, De Hann. Brunner (1893, p. 111).

Bolivar (1887, p. 284) gives the following measurements of *H. gracilis:* Length of body ♀, 9 mm.; pronot. 10–11·5 mm.; post. fem. 6 mm. For *festivus*, length of body ♂, 8 mm.; pronot. 9·5 mm.; post. fem. 6·5 mm. His figure 24–24*a* of *festivus* agrees with the specimens which form the basis of my descriptions.

24.—*Hedotettix gracilis abortus*, form. nov.

A short-wing form of *Hedotettix* which appears to be a variety of *gracilis* is represented by three specimens. This form differs from *gracilis* in having the frontal costa more widely sulcate; in the median carina of pronotum sloping backward instead of being arcuate; the pronotal process posteriorly abbreviate acute, extending backward only to the posterior femoral apex or little beyond; the wings extending very little beyond the pronotal apex; and differing as shown in the following measurements:—

Sex.	Length of Body.	Pronot.	Width of Shoulders.	Elytra.	Post. Fem.	Antennæ.	Wings.	Pronot. + P. or H. F.
♂	9·4	8·4	2·3	1·3	5·	2·9	+ ·1	+ ·5
♀	10·	9·	2·7	1·6	5·9	3·3	+ ·1	= ·0
♀	9·1	8·	2·6	1·3	5·6	—	+ ·1	= ·0

The above two females, Kesbewa (Colombo), April, 1903, "from dry rice fields." One male from Pundalu-oya, March 3, 1903, "swept from grass fields." I have a female example similar to this variety from Java, Pengalengan, 4,000 ft. elevation. Bolivar mentions that the species is found in Southern India, Ceylon, and Java. It is also mentioned by Brunner (1893) as occurring in Teinzo, Rangoon, in lower British India.

25.—*Hedotettix attenuatus*, sp. nov.

Plate III., figs. 18–18*b*.

Nearly related to *gracilis*, but having the body very slender, the vertex narrower than one of the eyes, the front margin subtruncate; the crown of head in profile not at all or barely elevated above the eyes; the frontal costa moderately or narrowly sulcate, the rami not appreciably widened between the eyes; the median carina of pronotum anteriorly not at all or slightly compressed between the sulci, the antero-dorsal margin strictly truncate, the dorsum between the shoulders narrow. The male very slender, having the eyes subexserted.

There are some individuals of this species which appear to connect it with *gracilis*, the measurements indicating this as well as the intermediate varieties of structures. Yet *attenuatus* is so distinct that it may be readily separated. It is moreover suggested here that *attenuatus* is a recently derived species originating from the *gracilis* type.

Measurements in Millimeters.

Long-wing Form.

Sex.	Length of Body.	Pront.	Width of Shoulders.	Elytra.	Post. Fem.	Antennæ.	Wings.	Pronot.+ P.& H. F.
♂	11·	8·5	1·9	1·2	4·5	2·8	+2·	—
♂	11·	8·5	1·9	1·2	4·5	2·9	+2·	—
♂	11·	8·5	1·9	1·2	4·5	3·	+1·9	—
♂	10·5	7·9	2·	1·	4·5	2·9	+1·9	—
♂	11·8	9·5	2·	1·2	4·7	3·	+1·5	—
♂	11·	8·4	1·9	1·1	4·5	2·9	+1·9	+2·
♀	13·2	10·5	2·5	1·6	5·5	3·1	+2·	—
♀	13·	10·5	2·4	1·5	5·5	—	+1·8	—
♀	14·	11·1	2·8	1·5	6·7	3·7	+2·	+1·5
♀	12·9	10·1	2·6	1·6	5·5	3·2	+2·	+1·9
♀	13·2	10·9	2·5	1·7	5·9	—	+2·	+2·
♀	13·2	10·1	2·5	1·5	5·5	3·5	+2·	+1·5
♀	14·	11·	2·8	1·6	5·9	3·5	+2·1	+2·5
♀	13·	10·	2·5	1·4	5·9	3·2	+2·1	—
♀	12·	9·2	2·1	1·2	5·5	3·	+2·	+1·2
♀	13·1	10·	2·5	1·5	5·9	3·1	+2·1	—
♀	12·8	10·	2·3	1·5	5·5	3·1	+1·8	—

The above series of seventeen long-wing specimens from Kesbewa (Colombo), April 4, 1903, were found in association with *Euparattetix personatus*, Bol., in rice fields and dry bed of tank. Living examples were very variable in colour ; sometimes with broad longitudinal stripe of emerald green. In the dried specimens the latter colour has entirely disappeared.

Gen. *Coptotettix*, Bol.

Body rugose or to certain degree granulate. Head not at all exserted. Vertex narrowed towards the front, flattened, frontal carinulæ between interrupted or leading abruptly backward. Frontal costa rounded, more or less produced. Antennæ inserted between the eyes, filiform elongate. Pronotum in front truncate, extended to apex of posterior femora or long very acutely subulate ; median carina depressed ; dorsum very rarely tectiform. Elytra oblong; wings abbreviated or caudate. Anterior femora often elongate, carinæ parallel ; posterior femora elongate, carinæ entire or to certain extent crenulate ; first article of posterior tarsi longer than the third.

Coptotettix, Bolivar (1887, p. 287).

KEY TO COPTOTETTIX SPECIES.

Pronotal process not extended backward beyond the posterior femoral apices; dorsum of pronotum tuberculose or rugose: median carina of pronotum anteriorly largely elevated.

fossulatus, Bol.

Pronotum posteriorly long subulate, extended backward beyond the posterior femoral apex; dorsum flattened, between the shoulders little convex, with rounded tubercles; wings caudate.

testaceus, Bol.

26.—*Coptotettix fossulatus*, Bol.

Pale gray fusco-variegated, rugose tuberculose. Head not at all exserted. Vertex equal in width to eye, on either side subfossulate, in front not produced. Frontal costa between the eyes strongly roundly arcuate. Antennæ inserted between the eyes. Pronotum anteriorly tectiform, posteriorly flattened extended to apex of abdomen; dorsum rugose tuberculose, behind the shoulders fossulate; median carina anteriorly largely elevated, posteriorly much interrupted; posterior process provided with compressed irregular carinulæ on either side beside the lateral carinæ, lobes of process deflexed strongly sinuate below; the posterior angle of lateral lobes wide, apices subrounded truncate. Elytra minute, subacuminate; wings abbreviated. Middle femora little widened, superior carina behind the middle less elevated; posterior femora wide; posterior tibiæ little spinose; first article of posterior tarsi strongly longer than the third; pulvillar apices acute, the third pulvillus longer than the second.

Length body ♂, 8 mm.; pronot. 7 mm.; post. fem. 4·5 mm. Locality, Ceylon.

Coptotettix fossulatus Bol. (1887, p. 288).

I have not seen this species.

27.—*Coptotettix testaceus*, Bol.

Testaceous flavescent, fusco-cinero-variegated. Head not at all exserted. Vertex narrower than eye, narrowed toward the front, viewed from above not at all produced before the eyes. Frontal costa arcuate subindistinctly sinuate before the median ocellus. Antennæ inserted between the eyes. Pronotum posteriorly subulate, dorsum flattened, between the shoulders little convex with rounded tubercles before the shoulders depressed, with two abbreviated carinulæ; posterior process rarely scattered with elongate rugæ; posterior angle of lateral lobes triangular, apices narrow subtruncate. Elytra oblong apices rounded reticulate; wings caudate. Femora streaked with fuscous narrow, elongate,

carinæ very obtusely undulate; posterior femora strongly granose; first article of posterior tarsi strongly longer than the third, above distinctly serrulate, the third pulvillus shorter than the first and second united.

Length of body ♀, 10 mm.; pronot. 12·5 mm.; post. fem. 7 mm. Locality, Ceylon, Bolivar (1887, p. 291).

Coptotettix testaceus, Bol.

EXPLANATION OF PLATES.

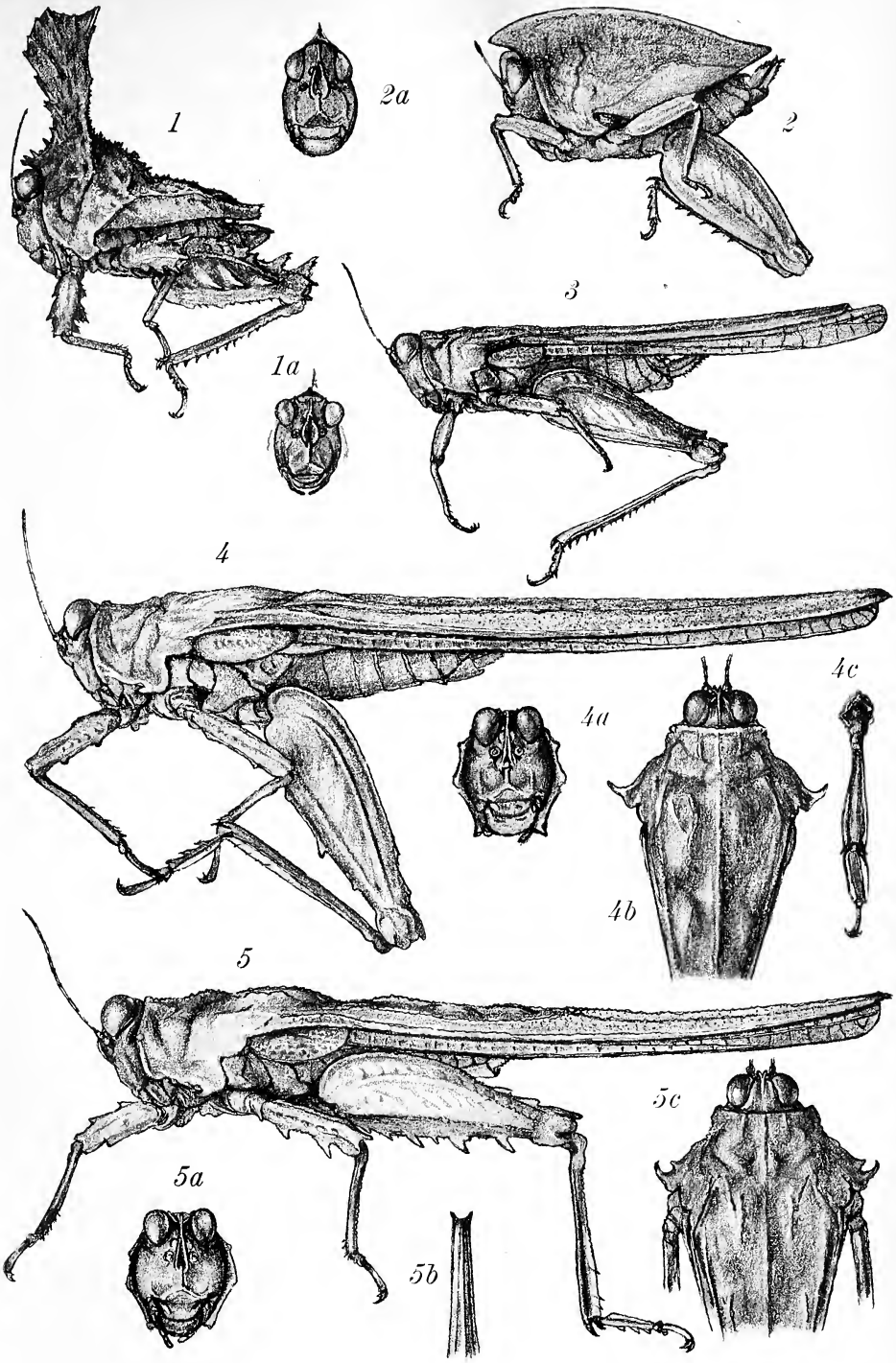
In making the figures of Plates I. and II. I have intentionally shown the species, when given in profile, with the legs hanging somewhat downward. This attitude shows more clearly the detail of their anatomy, especially the pronotum and elytra, parts of which would, if the insects were figured in their normal attitude, be obscured by the legs. All the drawings for the plates were made by the Author. The third plate shows in outline drawings the head as viewed from above including the vertex and eyes, the posterior angle of the lateral lobes of pronotum being also shown. The lower figures show the head viewed in profile, the latter being greatly magnified, while both of the preceding plates show the figures enlarged only about five diameters.

PLATE I.

Fig. 1.—Cladonotus latiramus, male, Kandy.
„ 1*a*. „ „ „ front view of head.
„ 2.—Deltonotus tectiformis, female, Pundalu-oya.
„ 2*a*. „ „ „ front view of head.
„ 3.—Loxilobus acutus, female, Pundalu-oya.
„ 4.—Scelimena gavialis, „ Pundalu-oya.
„ 4*a*. „ „ „ front view of head.
„ 4*b*. „ „ „ head and pronotum from above.
„ 4*c*. „ „ male, posterior tibia and tarsus.
„ 5.—Scelimena logani, female, Kandy.
„ 5*a*. „ „ „ front view of head.
„ 5*b*. „ „ „ apex of pronotal process.
„ 5*c*. „ „ „ head and pronotum from above.

PLATE II.

Fig. 6.—Lamellitettix acutus, female, Maskeliya.
„ 6*a*. „ „ „ head and pronotum from above.
„ 6*b*. „ „ „ front view of head.



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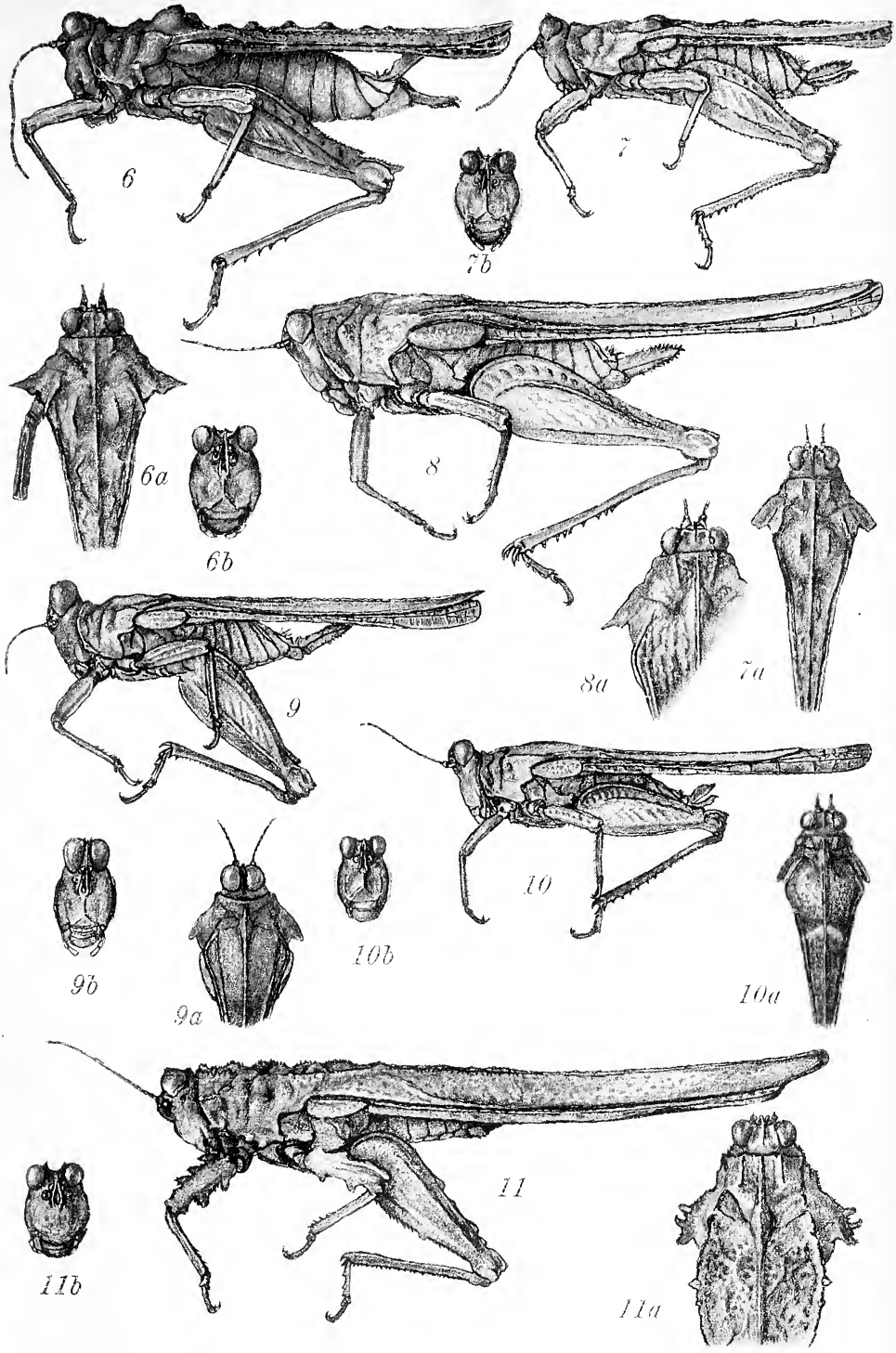

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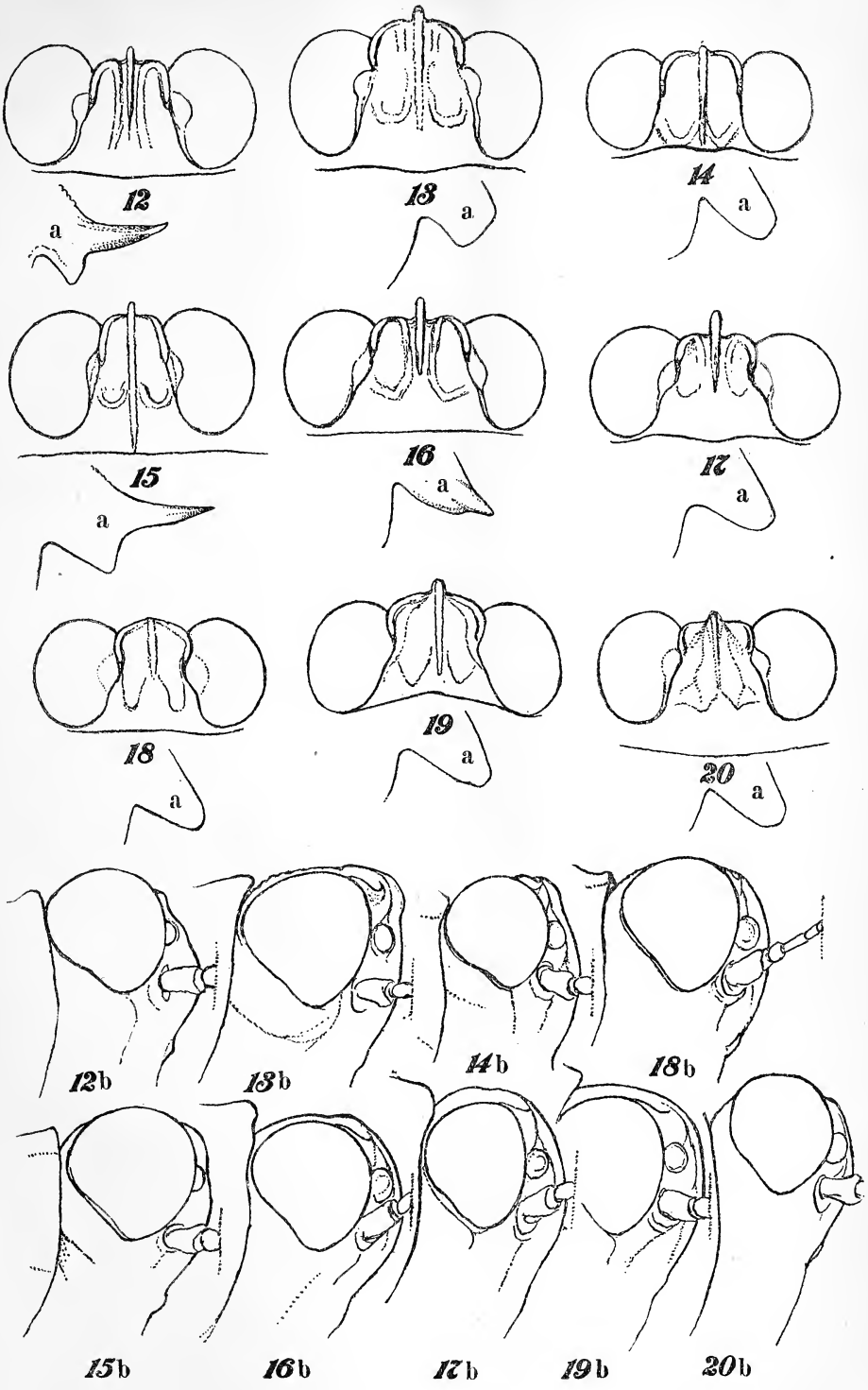

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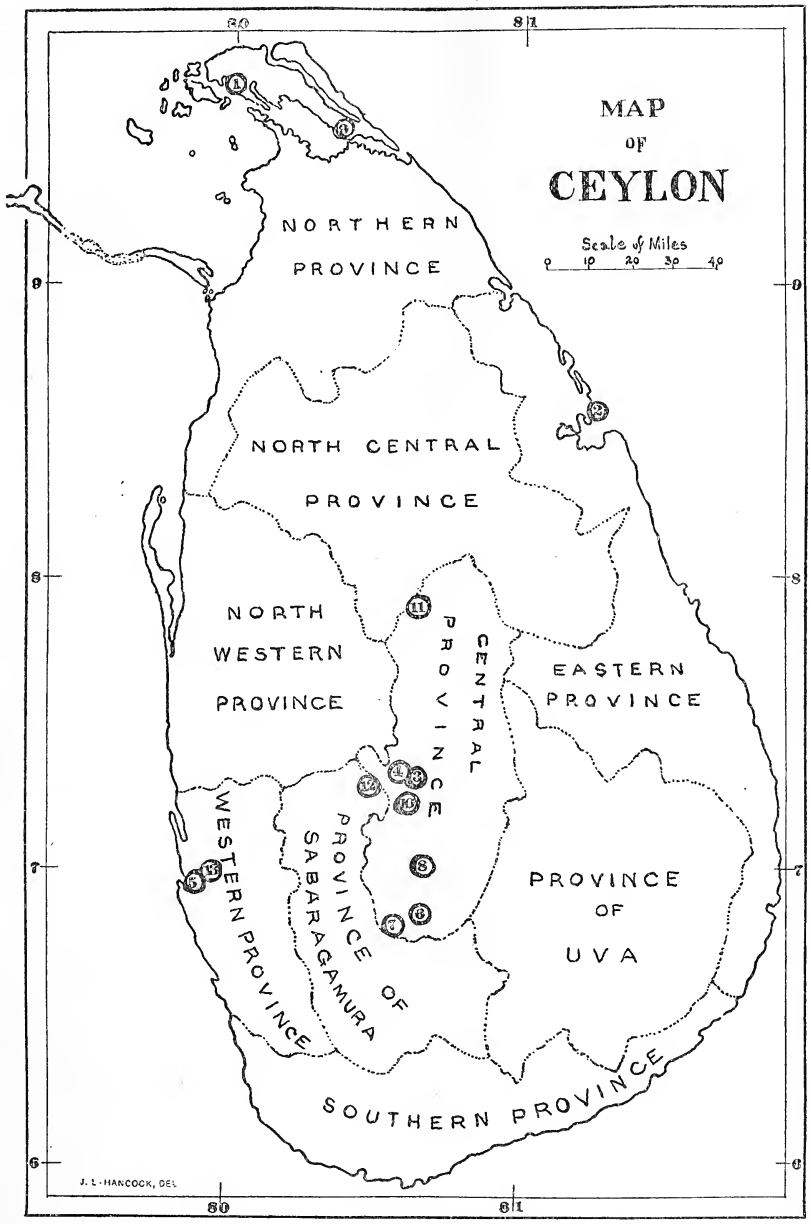

Map of Ceylon showing localities in which specimens of Tettigidæ (Orthoptera) were collected. The points indicated by figures surrounded by circles are as follows:—1 Jaffna, 2 Trincomalee, 3 Kandy, 4 Hantane, 5 Colombo, 6 Dikoya, 7 Maskeliya, 8 Pundalu-oya, 9 Elephant Pass, 10 Peradeniya, 11 Dambulla, 13 Kesbewa.

Fig. 7.—Mazarredia insularis, female, Pundalu-oya.
„ 7*a*. „ „ „ head and pronotum from above.
„ 7*b*. „ „ „ front view of head.
„ 8.—Acanthalobus miliarius, Colombo.
„ 8*a*. „ „ „ head and pronotum from above.
„ 9.—Systolederus greeni, female, Pundalu-oya.
„ 9*a*. „ „ „ head and pronotum from above
„ 9*b*. „ „ „ front view of head.
„ 10.—Euparatettix personatus, female, Colombo.
„ 10*a*. „ „ „ head and pronotum from above.
„ 10*b*. „ „ „ front view of head.
„ 11.—Gavialidium crocodilus, female, Pundalu-oya.
„ 11*a*. „ „ „ head and pronotum from above.
„ 11*b*. „ „ „ front view of head.

Plate III.

Fig. 12.—Criotettix spinilobus, female, head from above.
„ 12*a*. „ „ „ lateral lobe of pronotum from above.
„ 12*b*. „ „ „ head viewed from side.
„ 13.—Apterotettix obtusus, female, head from above.
„ 13*a*. „ „ „ lateral lobe of pronotum.
„ 13*b*. „ „ „ head viewed from side.
„ 14.—Tettix atypicalis, female, head from above.
„ 14*a*. „ „ „ lateral lobe of pronotum.
„ 14*b*. „ „ „ head viewed from side.
„ 15.—Criotettix tricarinatus, female, head from above.
„ 15*a*. „ „ „ lateral lobe of pronotum.
„ 15*b*. „ „ „ head viewed from side.
„ 16.—Loxilobus acutus, female, head from above.
„ 16*a*. „ „ „ lateral lobe of pronotum.
„ 16*b*. „ „ „ head from side.
„ 17.—Loxilobus rugosus, female, head from above.
„ 17*a*. „ „ „ lateral lobe of pronotum.
„ 17*b*. „ „ „ head from the side.
„ 18.—Hedotettix attenuatus, female, head from above.
„ 18*a*. „ „ „ lateral lobe of pronotum.
„ 18*b*. „ „ „ head from the side.

Fig. 19.—Hedotettix gracilis, female, head from above.
„ 19*a*. „ „ „ lateral lobe of pronotum.
„ 19*b*. „ „ „ head viewed from the side.
„ 20. Euparatettix personatus, female, head from above.
„ 20*a*. „ „ „ lateral lobe of pronotum.
„ 20*b*. „ „ „ head viewed from the side.

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NOTES.

1. *Miscellaneous Insects from Ceylon.*—The following examples illustrative of various aspects of insect life in Ceylon were exhibited by Mr. E. E. Green at a meeting of the Entomological Society of London on the 1st of June, 1904.

(i) A Carpenter bee (*Xylocopa fenestrata*, Fab.) and a large Asilid fly (*Hyperechia xylocopiformis*, Wlk.) which very closely mimics the bee. The fly now exhibited was observed circling round a *Xylocopa* and was then mistaken for the male of that insect. But its subsequent attitude, when at rest, betrayed its true nature and led to its capture.

(ii) Specimens of a Mycetophilid fly and cocoons from which they emerged. The latter are attached to leaves and pieces of wood and show a beautiful structure, being formed of an open network of white anastomosing threads.

(iii) Examples of a Tineid moth and its remarkable larval cases. The case consists of a narrow tube, more than an inch long, with numerous short diverticula at regular intervals along each side. The larva anchors this case to the bark of the tree and exserts its head from either extremity, or from any of the lateral diverticula, to feed upon the surrounding lichens and minute algæ. When it has exhausted the food within reach, it severs the connecting strands and drags the case to a fresh part. Above the middle of the tubular case is a thickened pad, beneath which the larva rests when moulting and under which it finally pupates.

SPOLIA ZEYLANICA.

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CONTENTS.

With five Plates and two Illustrations.

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1905.

ON TOXORHYNCHITES IMMISERICORS (WALKER), THE ELEPHANT MOSQUITO.

By E. Ernest Green, F.E.S.,

Government Entomologist, Ceylon.

With Plate.

Megarhinus immisericors, Walk. (Journ. Proc. Linn. Soc., Lond., IV., p. 91, 1860; and VII., p. 202).

Culex regius, Thwaites (?).

Megarhinus immisericors (♂), Theobald, Mono. Culic., I., p. 225, pl. VII., fig. 28.

Megarhinus gilesii (♀), Theobald, Mono. Culic., I., p. 227, pl. IX., fig. 33.

Megarhinus subulifer, Dolleschall, Nat. Tijdschr. v. Ned. Ind., vol. XIV., p. 382.

Toxorhynchites immisericors (Walker), Theobald, Mono. Culic., vol. III., p. 123.

THE genus *Toxorhynchites* of Theobald (Monograph of the Culicidæ, vol. I., p. 244) differs from typical *Megarhinus*, to which it is otherwise very closely allied, in the short palpi of the female. It resembles *Megarhinus* in the unusually large size, brilliant colouring, and angled proboscis of both sexes (see fig. 1). The lateral margins of the terminal segments (more particularly in the male) are often densely tufted in both *Megarhinus* and *Toxorhynchites* (fig. 2).

T. immisericors, though by no means so plentiful as many other Culicidæ, is not an uncommon insect in the Royal Botanic Gardens, Peradeniya (altitude 1,500 feet). I have taken it also in Pundalu-oya, at an elevation of over 4,000 feet. The adult insect may be found resting on the trunks of trees and—still more frequently—upon the stems of the Giant Bamboo (*Dendrocalamus giganteus*). It occasionally flies in at the open window of a room (always in the daytime), when its loud deep hum immediately attracts attention to its presence. It appears to be a distinctly day-flying insect.

Though this species is popularly known by the names of "Elephant Mosquito" and "Stinging Elephant Mosquito," I have

never experienced its bite, nor have I been able to induce it to bite me by methods successful with other biting Culicidæ. Theobald quotes Captain James to the effect that "it bites very severely in South India, and that its bite is very poisonous" (Mon. Culic., I., p. 226). I have been unable to ascertain the origin of the name "Elephant Mosquito." Does it attack the elephant? Or has its large size and bent proboscis earned for it this sobriquet?

Besides Ceylon, the species is recorded from Travancore, Nilghiris, Sikkim, Celebes, Waigiou, Mysol, North Ceram, Burma, and Amboina.

I have kept the female insects alive for varying periods up to eleven days, feeding them on sliced plantains.

Wishing to study the early stages of the insect, I confined a female under a bell glass over a shallow vessel of water. Eggs were freely deposited. They are scattered singly and separately on the surface of the water, and do not tend to run together in strings, as do the eggs of *Anopheles*. The egg (fig. 3) is of a regular oval form, 0·55 mm. long by 0·37 mm. broad; of a creamy white colour; the surface closely studded with spinose granules, some of which are larger than the rest and disposed at more or less regular intervals. Each of these larger granules has a prominent apical point (fig. 4). When crushed under a cover glass the granules readily become detached from the surface of the egg. This granular formation doubtless accounts for the buoyant manner in which it floats, the whole contour of the egg being visible above the surface film. The actual operation of egg-laying was not seen, but the female was observed jerking itself up and down in the air just above the water, and it seems probable that the eggs were shed at that time.

Some of the eggs hatched in two days' time. They divide transversely across the equator to liberate the larva. The empty halves float on the surface with the convexity upwards.

The young larvæ rest almost horizontally, though they have a well-defined respiratory tube. Viewed from above, the position appears to be quite horizontal; but from the side it can be seen that the body lies at a slight angle, the extremity of the spiracular tube only engaging with the surface film.

The form of the newly hatched larva may be understood by reference to fig. 5. The head is large and somewhat quadrate; the thorax broader, but shorter than the head; the abdominal segments much narrower, their lateral margins strongly produced; the terminal segment abruptly truncate. Respiratory tube short and stout, with four small flattened rays at its extremity. The sides of thorax and abdominal segments are furnished with

fascicles of long bristles, increasing in length from in front to the fifth abdominal segment, and from thence decreasing again. There are four long bristles from the extremity of the body. The lateral bristles are weakly and loosely plumose ; those from the posterior extremity are simple (fig. 6). There are no caudal fins. The head and terminal segments are more densely chitinous than the other parts. The paired air sacs can be plainly distinguished lying in the thoracic region and communicating with the respiratory tube by two long tortuous tracheæ.

Instead of the brush-like organs (or whorl organs) noticeable in *Anopheles* and many other larval Culicidæ, there are two series of five or six stout falcate chitinous lamellæ (see fig. 7) articulated to the antero-lateral margin of the clypeus. When at rest they are kept folded together and turned back on each side of the head, where they look like a pair of buffalo horns (see fig. 8). Each separate lamella is minutely toothed at its extremity. The structure of these organs immediately suggested a carnivorous habit—a theory fully borne out by subsequent observation. The antennæ are rather short and stout, with three or four short bristles at the extremity and two longish hairs on the sides. The mandibles are the most conspicuous parts of the mouth. They are armed with stout black teeth, the exterior two long and spiniform. The maxillary palps are stout oblong pieces, each with two small teeth at its extremity, the maxillæ themselves being broader, the outer edge set with short bristles and a group of small but stout teeth at the inner angle. Between the mandibles are some stout hairs, apparently attached to the under surface of the clypeus. The neck is mobile and extensible, but the head is never rotated like that of larval *Anopheles*. The pliancy is probably necessitated by the struggles of the victim when first captured.

Confirmation of the supposed carnivorous habit was soon forthcoming: firstly, by the rapid disappearance of most of the young larvæ while the remainder waxed fat ; and secondly, by the detection of one larva in the act of devouring a comrade of the same size as itself. It had seized it by the posterior extremity.

I then placed one of the *Toxorhynchites* larvæ in a watch glass with some water, and introduced the smaller larva of a *Culex*. As soon as the latter approached it was instantly seized. The attack was so rapid that, though I was following the movements of the insects through a lens at the time, I was unable to see the exact mode of procedure. Within two minutes' time nothing but the head of the victim remained. Subsequent observation showed that the falcate lamellæ were the organs of prehension. The larvæ are very sluggish, remaining—unless

disturbed—in one position until their prey comes within striking distance. The lamellate organs then spring forward like the jaws of a rat trap, but almost instantly revert to their former position, the food being now held and manipulated by the proper mouth parts.

Though well supplied with *Culex* larvæ, the young *Toxorhynchites* continued to prey upon each other until but a single survivor remained in each vessel. Having a habit of backing blindly about in the water, they sooner or later come within reach of the jaws of their companions.

As the larva increases in size the body assumes a bright reddish tint above, the ventral parts remaining paler. The head and terminal parts become olivaceous brown.

In spite of every attention and an ample supply of food, not a single larva reached maturity. I am consequently unable to state the time occupied in development from egg to mosquito. But the natural breeding-place of the insect was discovered: in the hollow stumps of the giant bamboos and in small pools in the angles of the branches of other trees, whence examples in all stages were obtained. Such natural receptacles of water are nearly always swarming with the larvæ of various mosquitoes, more particularly with those of *Stegomyia scutellaris* and *Desvoidea obturbans*, and each receptacle usually contained a single larva of *Toxorhynchites*, seldom more than one, unless they were quite young. Many others had probably started life there, but—in the manner mentioned above—had gradually fallen victims to the strongest member. This fact will account for the comparative scarcity of the adult *Toxorhynchites*, and greatly minimizes its usefulness as a Culex destroyer.

The fully grown larva of *Toxorhynchites immisericors* is a giant of its kind, averaging 16 mm. in length, and of a very robust build. It is of a dull reddish purple colour above, paler beneath; opaque. Theobald gives a good figure of the larva (Mon. Culic., III., p. 118), but the remarkable raptorial organs are not displayed. The front of the head is deeply emarginate, and bears two fine simple bristles. The falcate lamellæ now number nine on each side, and end in a simple curved point. The antennæ are comparatively small and slender. They bear two fine hairs on one side, a little below the apex, and a few small points at the extremity. The body-bristles are very weakly plumose, and spring—in loose fascicles—from densely chitinous tubercles. There is a small but more densely plumose bristle on each side on the dorso-lateral area of the metathoracic segment. The stout respiratory siphon is of about the same length as

the terminal segment. There are no caudal fins, but a dense flattened tuft of paired strongly plumose bristles springs from th under surface of the posterior extremity. The mandibles are stout and strongly armed, the maxillæ and maxillary palps small and inconspicuous.

Fully grown larvæ, taken from the hollow bamboo stumps, were usually found to be thickly encrusted with *Vorticellæ*.

The pupa rests with the dorsum of thorax and base of abdomen horizontal, the remainder of the abdomen being sharply curved under. Theobald's figure (*loc. cit.*) has evidently been made from an ill-preserved specimen. Fig. 9 of the present paper will give a better idea of its natural form and posture. It is very robust, of a deep olivaceous brown colour, the intersegmental membrane dull purple. A pair of long bristles projects forwards, one from the base of each eye. The caudal fins (fig. 10) are broadly rounded and fringed with fine short hairs.

A living pupa placed in 4 per cent. formol lived, without apparent inconvenience, for twenty-four hours, when it was removed and killed in strong alcohol.

The adult mosquito makes its appearance in from five to six days after pupation. A freshly emerged example is a truly handsome insect, glowing with iridescent purple and blue tints, which, in conjunction with the caudal tufts, gives it very much the look of a Sesiid moth. Theobald's description (*loc. cit.*, I., p. 225) answers closely to my specimens. In fresh examples the pleuræ are densely clothed with silvery white scales. In all my examples of the male the tarsi of the first pair of limbs are entirely dark. On the mid-leg the tarsi usually have two pale bands, but they are often much reduced and sometimes entirely absent. The tarsi of the hind limbs have always a single broad white band. In the female the white bands are more conspicuous and constant. The basal half of the front tarsi are entirely white, the mid tarsi carry two broad white bands, and the hind tarsi a single broad band.

What is now recognized by Theobald as the female of *T. immisericors* was described and figured in his first volume under the name of *Megarhinus gilesii*. I find in my examples a broad purple-blue median band on the venter, not mentioned by Theobald. In fresh examples the thorax is densely clothed with bronze-green scales.

EXPLANATION OF PLATE.

Toxorhynchites immisericors.

Fig. 1.—Female, side view, × 5.

Fig. 2.—Abdomen of male, dorsal view, × 6.

Fig. 3.—Egg, × 40.

Fig. 4.—Aciculate granule from surface of egg, × 650.

Fig. 5.—Newly hatched larva, dorsal view, × 40.

Fig. 6.—Newly hatched larva, terminal segments, side view, × 100.

Fig. 7.—Young larva, head, ventral view, × 75.

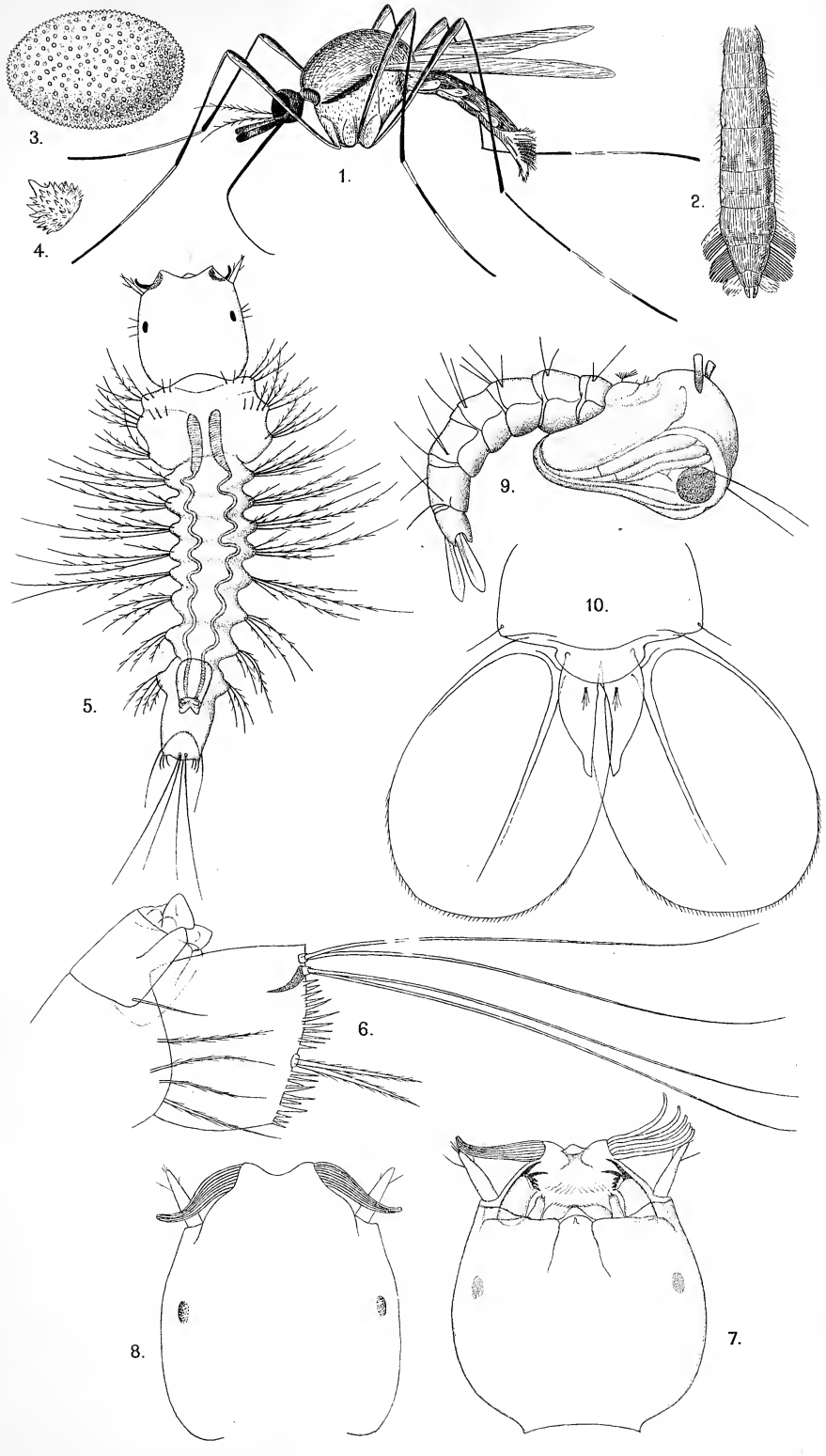
Fig. 8.—Young larva, head, dorsal view, with raptorial organs retracted, × 75.

Fig. 9.—Pupa, side view, × 6.

Fig. 10.—Pupa, extremity of body and caudal fins, dorsal view, × 15 (from empty pupal skin).

Royal Botanic Gardens,
Peradeniya, March, 1904.

Spolia Zeylanica.



E. E. Green, del.

E. Wilson, Cambridge.

TOXORHYNCHITES. GREEN.

ANOPHELINÆ FOUND IN CEYLON.

By ALBERT J. CHALMERS, M.D., F.R.C.S.,

Registrar of the Ceylon Medical College.

With Maps.

1.—INTRODUCTION.

I HAVE only travelled in Ceylon in the end of the dry season, which is not the best time to collect mosquitoes; but I have visited a considerable number of places, and think it might be of interest to place on record in definite form the names of the Anophelinæ which I have recognized.

The great months for mosquitoes are after the north-east monsoon rains, viz., December and January; during this time I have always resided in Colombo.

I am much indebted to Sir Allan Perry, Principal Civil Medical Officer, for the opportunities given me to make these journeys and to collect these observations, some of which are already published in his report (8).*

By the kindness of Mr. E. E. Green of Peradeniya, to whom I am very much indebted, I have been allowed to enter in this paper the places and the species which he has found in Ceylon (6).*

Mr. Green has captured Anophelinæ at other times than the end of the dry season, and I have thought it better to add these seasons as well to my list.

By the kindness of Dr. Philip, Medical Officer of Health, Colombo, I am permitted to draw attention to his observations (10).*

I also invite attention to the work of Major Manders, R.A.M.C., late of Trincomalee (9).*

This paper is Part II. of a report on the Prevention of Malaria in Ceylon submitted to the Government of Ceylon, by whose kind permission it is allowed to be printed.

* These numbers indicate the references at the end.

2.—List of Species found in Ceylon.

I have recognized the following species of the Anophelinæ in Ceylon, and Mr. Green of Peradeniya has found one species, *Nyssorhynchus maculatus*, which I have not found, but which is included to make the list complete. The names are those given in Theobald's Monograph on the Culicidæ of the World, vol. III.

(1) Genus Myzomyia (Blanchard) :—

Species 1 : Myzomyia Rossii (Giles).
Species 2 : Myzomyia culicifacies (Giles).
Species 3 : Myzomyia Listoni (Liston).

(2) Genus Myzorhynchus (Blanchard) :—

Species 4 : Myzorhynchus barbirostris (Van der Wulp).

(3) Genus Nyssorhynchus (Blanchard) :—

Species 5 : Nyssorhynchus maculipalpis (Giles).
Species 6 : Nyssorhynchus fuliginosus (Giles).
Species 7 : Nyssorhynchus Theobaldi (Giles), found by Mr. E. E. Green.

(4) Genus Pyretophorus (Blanchard) :—

Species 9 : Pyretophorus jeyporensis (Theobald).

(5) Genus Cellia (Theobald) :—

Species 10 : Cellia argyrotarsis (Robineau-Desveidy).

The most common are the Myzomyia Rossii, Myzomyia culicifacies, Myzorhynchus barbirostris. The Anophelinæ found in Ceylon are the same species as those found by Stevens, Christophers, James, and others in India, and are different from those of Africa and America.

A doubtful species is noted, *Nyssorhynchus Jamesii*, by Dr. Philip, from Mutwal, Colombo, named from a damaged specimen.

3.—Conditions of Life.

Ceylon, with its damp warm climate and its abundant collection of water in rivers, wewas, pokunas, kulams, paddy fields, &c., is very suitable for the life of Anophelinæ. But the conditions under which they exist at the end of the dry season can hardly be said to be the most favourable. The tanks are shrunk and dried up, the rivers are very low, and small pools, except as the remnants of much larger collections, are not in existence ; but Ceylon is peculiarly well supplied with water from the two wet seasons of the south-west and north-east monsoons, and by the system of irrigation tanks or wewas, by its numerous rivers, by its smaller collections of water in pokunas, kerneys, wells, and paddy fields, and therefore even at the end of the dry season there is some water at places scattered all over the Island. I have

found the larvæ of the Anophelinæ in the rivers, wewas, the pokunas, the kerneys, and the paddy fields, and at times in wells under conditions presently to be described. The greatest enemy of the larvæ appears to be fish. The adults of many of the species can only be found with great difficulty, and some not at all, in the end of the dry season; while other species are most abundant and can be easily obtained.

I now propose to discuss certain conditions in the life of the various species.

(1) *Myzomyia Rossii* (Fig. 2).

This species appears to occur all over Ceylon, and probably at all times of the year, but it is extremely noticeable in Jaffna and elsewhere that, when it is difficult to find other species of Anophelinæ, it is easy to find Rossii, and the reason appears to be that it is not particular as to the kind of water in which it breeds. It seems always to be associated with human habitations. The adults show considerable variation in the wings, as pointed out by James (3). The number of males produced at one time is most remarkable. I found a large swarm of males at Batticaloa with but few females.

The eggs can be easily found and easily recognized by the characters set forth by Stephens and Christophers (2), (4), and James (3). The larvæ can be found in the wewas, kulams, pokunas, kerneys, pools, puddles, drippings by the side of wells in fresh and brackish water, and in paddy fields with water, if there are no prawns or fish, or if there is sufficient weed to protect them. I have only once found the larvæ in a running river, but never in deep dark wells, and I agree with Manders that, as a rule, Anopheles larvæ prefer sunshine. I have noticed at times that on the shady side of a pool there will be few larvæ, while on the sunny side there will be large quantities, but there are exceptions to this. Their great enemies, as in the case of all larvæ, are prawns and fish.

The characters of the larvæ are those set forth by Stephens and Christophers (2), (4), and by James (3), but the palmate hairs are not so constant as represented by them, for, while they are found on the second to the seventh segment inclusive, they may be well developed on the first or on one side of the first and not on the other side.

The larvæ differ in colour according to habitat, being dark in the paddy fields, green in green pools, and whitish in the white sandy pools of certain parts of Jaffna. This appears to me to be

protective. The larvæ are omnivorous and cannibalistic. They are often the subjects of parasitism of such animals as vorticella, &c.

I have not observed any particular features about the pupæ.

(2) *Myzomyia culicifacies* (Fig. 3).

The adult is difficult to be found in the end of the dry season, but the larvæ are abundant. They are to be found in clear running water, and the best place to look for them is in the rivers, where they can be found in the back eddies by the bank, near or associated with weeds. I have found them at places scattered along the same river for about fifty miles.

They seem particularly abundant in the rivers of lower Uva. I have also found them in the edges of quickly running little streams if there are weeds. I have never found them in dirty or stagnant water. I have found the larvæ in wells in which the water was near the surface, and into which light penetrated easily.

(3) *Myzomyia Listoni* (Fig. 4).

I have only found the larvæ of this species at Batticaloa in the pools of what was originally a running stream, and at Tangalla.

(4) *Myzorhynchus barbirostris* (Fig. 5).

The adults of this species have been easily found in nearly all the places in which they are marked. They appear to be present at all times of the year, but their known distribution in Ceylon is peculiar, being only in south and west. However, future investigations may show them to be present in the other regions.

The larvæ are easily found, and are rather easily known, owing to the third abdominal segment being light in colour, whereas in general appearance they are black and large.

The larvæ were only found by me in clean water. I have not noticed them in running water, only in clear pools. There seems to be some slight variation in the palmate hairs, viz., the second segment hair may be poorly developed, and there may be at times a badly developed hair on the first abdominal segment with well-developed ones from the second to the seventh. I have found it quite green ; probably this was protective.

(5) *Nyssorhynchus maculipalpis* (Fig. 6).

The adults have been found by me in Colombo and sent to me by the Medical Officer of the jail at Mahara. They are difficult to find and recognize. The larvæ were found in a little trickling stream running from a spring to a well at Mahara and in the pools along this stream, and in similar little streams and pools in other places.

(6) *Nyssorhynchus fuliginosus* (Fig. 7).

For a detailed account of this Anopheles and its larvæ see Major Manders' paper (9). The larvæ are green in colour, and it should be noted that there are rudimentary palmate hairs on the first abdominal segment (and more rarely a very rudimentary one on the thorax), at times well developed from second to seventh inclusive. I found these larvæ in the weedy edges of the large wewa at Tissamaharama.

(7) *Nyssorhynchus Theobaldi* (Fig. 8).

I found the larvæ of this Anopheles living in streams among the vegetation. The characters laid down by James (3) appear correct.

(6) *Nyssorhynchus maculatus* (Fig. 9).

I have not met this species, which so far has only been found by Mr. Green.

(9) *Pyretophorus jeyporensis* (Fig. 10).

I have found the larvæ of this species in pools with clear water.

(10) *Cellia argyrotarsis* (Fig. 1).

I have found the adults and the larvæ, the latter in clear pools.

3.—The Geographical and Seasonal Distribution.

These species of Anopheles have been found in the following places at the months mentioned :—

(1) *Myzomyia Rossii* (Fig. 2).

Jaffna town	... September	Urelu	... September
Irrupali	... do.	Mullaittivu	... do.
Koppai	... do.	Batticaloa	... do.
Nirveli	... do.	Do. (Green)	April
Chiruppiddi	... do.	Galle	... —
Avarankal	... do.	Colombo	... June, July, August, September, October, November
Pallai	... do.		
Kankesanturai	... do.		
Krimalai	... do.		
Punnalai	... do.		
Chulipuram	... do.	Mahara	... October
Navali	... do.	Polgahawela	... May
Uduvil	... do.	Rambukkana	... September
Chunnakam	... do.	Matale	... do.
Mariddipuram	... do.	Maduella	... do.
Malakam	... do.	Dambulla	... do.

Madatiyana	... September	Badulla	... September
Kekirawa	... do.	Bandarawela	... do.
Anuradhapura	... do.	Haputale	... do.
Habarana	... do.	Dampalla	... do.
Mihintale	... do.	Wellawaya	... do.
Kanakarayan-kulam	... do.	Maduela	... do.
Mankulam	... do.	Madiligama	... do.
Chavakachcheri	... do.	Tangalla (Green)	... April
Kurunegala	... February and March	Pundalu-oya (Green)	... February
Bibile	... September	Peradeniya (Green)	January, March, December
Medagama	... do.		
Lunugala	... do.		

(2) *Myzomyia culicifacies* (Fig. 3).

Medagama	... September	Tellula	... September
Lunugala district	do.	Marawila	... do.
Badulla	... do.	Hambantota	... do.
Wellawaya	... do.	Mutwal	... July

(3) *Myzomyia Listoni* (Fig. 4).

Batticaloa	... September
Tangalla	... do.

(4) *Myzorhynchus barbirostris* (Fig. 5).

Medagama	... September	Puttalam	... March
Lunugala District	do.	Galgamuwa (Green)	... August
Wellawaya	... do.	Yatiyantota (Green)	... March
Tangalla	... do.	Peradeniya (Green)	January, September, October, November
Matara	... do.		
Galle	... do.		
Colombo	... September, October, November		
Mahara	... October		

(5) *Nyssorhynchus maculipalpis* (Fig. 6).

Lunugala District	September	Mahara	... October
Bandarawela	... do.	Colombo	... do.
Koslanda	... do.		

(6) *Nyssorhynchus fuliginosus* (Fig. 7).

Bibile	... September	Trincomalee (Manders)	... November, December, January, February, March, April, May, June
Tissamaharama	... do.		
Trincomalee (Green)	... March, April, May		
Galgamuwa (Green)	... August		

(7) *Nyssorhynchus Theobaldi* (Fig. 8).

Lunugala District ... September

(8) *Nyssorhynchus maculatus* (Fig. 9).

Peradeniya (Green) ... June, July, September, October, December

Pundalu-oya (Green) ... February

(9) *Pyretophorus jeyporensis* (Fig. 10).

Galle District ... September

(10) *Cellia argyrotarsis* (Fig. 1).

Kurunegala ... February and March

Near Anuradhapura ... September

4.—Relationship to Malaria.

It is now well known that it is not every species of the Anopheles which can carry the malarial parasite, and of those existing in Ceylon I think that it can be definitely stated that *Myzomyia Rossii* has nothing to do with the spread of malarial fever.

I have also failed to find the parasite in *Myzorhynchus barbirostris*, which is also to be considered as a non-carrier of malaria.

Of the Anophelinæ found in Ceylon which are recognized to be malaria-carriers, *Myzomyia culicifacies* is the best known. And this is the one found associated with epidemics in Ceylon, *e.g.*, at Mutwal, and with the bad malarial districts, *e.g.*, Medagama, in the Province of Uva.

Myzomyia Listoni is known to carry the germ in India. *Nyssorhynchus maculipalpis* is doubtful, and *Pyretophorus jeyporensis* is suspected, but neither these nor any of the others have been proved as yet without doubt to be spreaders of malaria.

I suspected *Nyssorhynchus maculipalpis* as the cause of the spread of fever at Mahara jail, but did not get sufficient for dissection purposes, and therefore cannot say definitely.

There is a great difference between West Africa and Ceylon. In West Africa about 50 per cent. of the Anopheles I dissected, which were *Anopheles costalis*, now called *Pyretophorus costalis*, and the little mosquito which I called *Anopheles Kumassi* (7), contained the germ.

5.—Future Investigations.

The knowledge of the Anophelinæ in Ceylon is very imperfect. They have never been studied in the wet season. Nothing is known about their distribution in the months of December and January. Only *Rossii* and *barbirostris* have been dissected in any number, consequently the relationship of the species of Anopheles to malaria in Ceylon has yet to be clearly made out.

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(6) Green: Circular, Series I., No. 25, of the Royal Botanic Gardens, Peradeniya, page 368.

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(8) Chalmers: Principal Civil Medical Officer's Administration Report, 1901, page A 2.

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(10) Philip: Circular of the Municipal Council of Colombo, No. 1,380, of 30th July, 1904.

MAPS.

Fig. 1.—Map of Ceylon, showing the Provinces and a few important towns and the distribution of *Cellia argyrotarsis*.

Fig. 2.—The distribution of *Myzomyia Rossii*.

Fig. 3. „ „ „ *culicifacies*.

Fig. 4. „ „ „ *Listoni*.

Fig 5. „ „ *Myzorhynchus barbirostris*.

Fig. 6. „ „ *Nyssorhynchus maculipalpis*.

Fig. 7. „ „ „ *fuliginosus*.

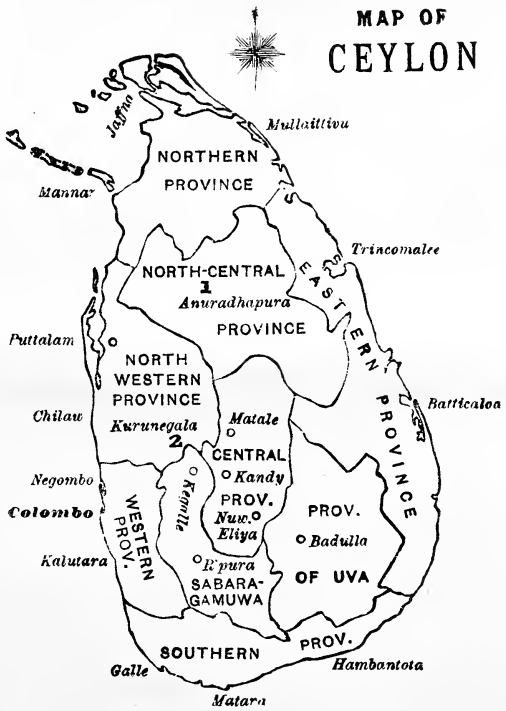
Fig. 8. „ „ „ *Theobaldi*.

Fig. 9. „ „ „ *maculatus*.

Fig. 10. „ „ *Pyretophorus jeyporensis*.

FIG. 1.

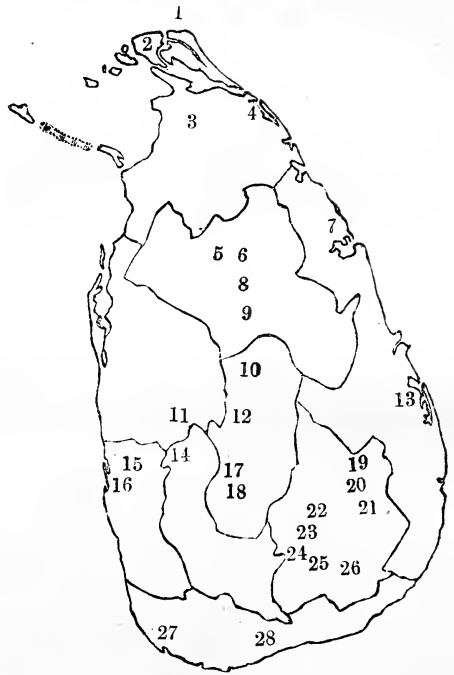
CELLIA ARGYROTARSIS.



1 Anuradhapura; 2 Kurunegala

FIG. 2.

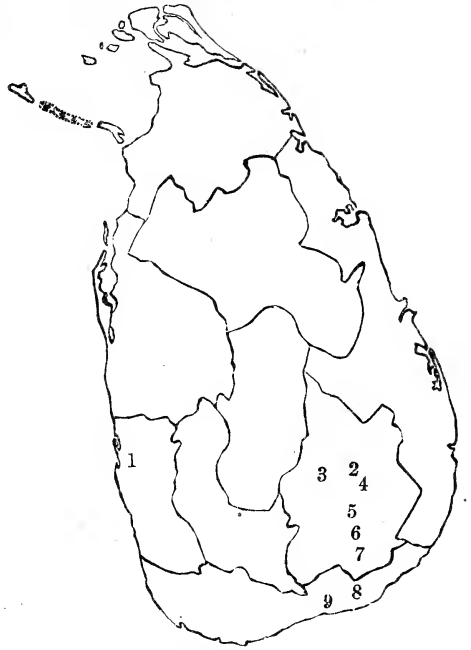
MYZOMYIA ROSSII.



1 Point Pedro	11 Kurunegala	21 Medagama
2 Jaffna	12 Matale	22 Badulla
3 Mankulam	13 Batticaloa	23 Bandarawela
4 Mullaittivu	14 Polgahawela	24 Haputale
5 Anuradhapura	15 Mahara	25 Koslanda
6 Mihintale	16 Colombo	26 Wellawaya
7 Trincomalee	17 Peradeniya	27 Galle
8 Kekirawa	18 Pundalu-oya	28 Tangalla
9 Dambulla	19 Bibile	
10 Maduela	20 Lunugala	

FIG. 3.

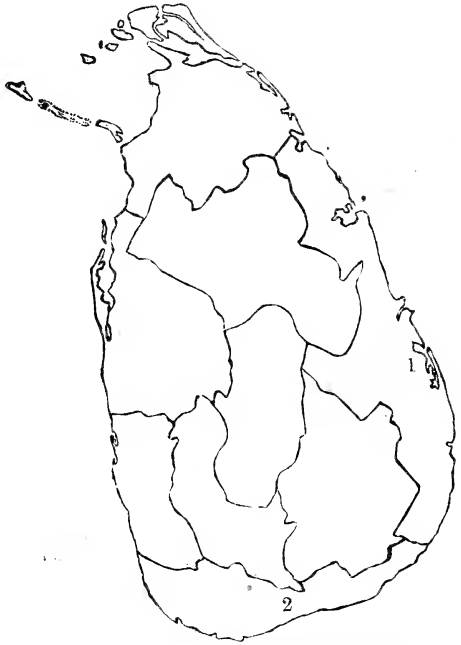
MYZOMYIA CULICIFACIES.



1 Colombo
2 Lunugala
3 Badulla
4 Medagama
5 Wellawaya
6 Telulla
7 Tanamalwila
8 River near Tissa
9 Hambantota

FIG. 4.

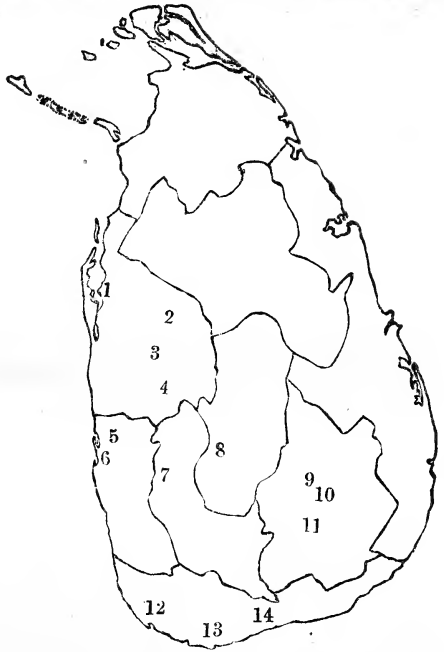
MYZOMYIA LISTONI.



1 Batticaloa; 2 Tangalla

FIG. 5.

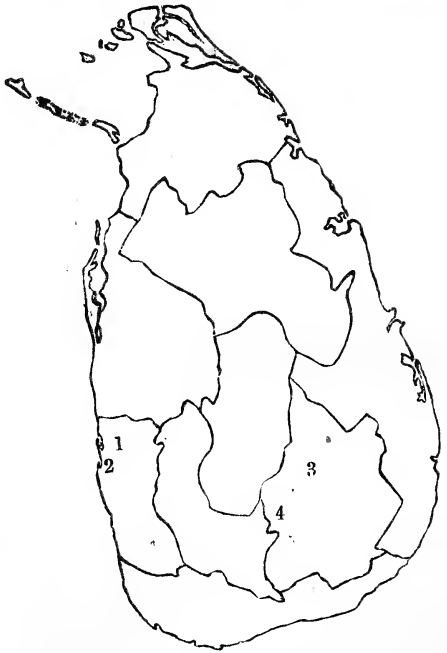
MYZORHYNCHUS BARBIROSTRIS.



1 Puttalam
2 Galgamuwa
3 Balalla
4 Kurunegala
5 Mahara
6 Colombo
7 Yatiyantota
8 Peradeniya
9 Lunugala
10 Medagama
11 Wellawaya
12 Galle
13 Matara
14 Tangalla

FIG. 6.

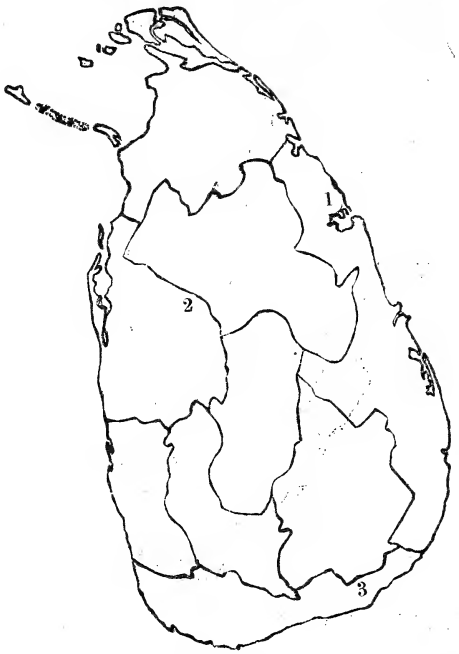
NYSSORHYNCHUS MACULIPALPIS.



1 Mahara
2 Colombo
3 Lunugala
4 Bandarawela
5 Koslanda

FIG. 7.

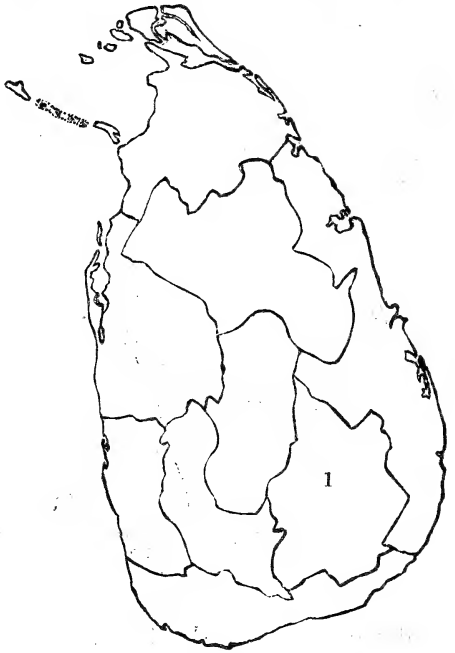
NYSSORHYNCHUS FULIGINOSUS.



1 Trincomalee: 2 Galgamuwa; 3 Tissamaharama

FIG. 8.

NYSSORHYNCHUS THEOBALDI.



1 Lunugalä

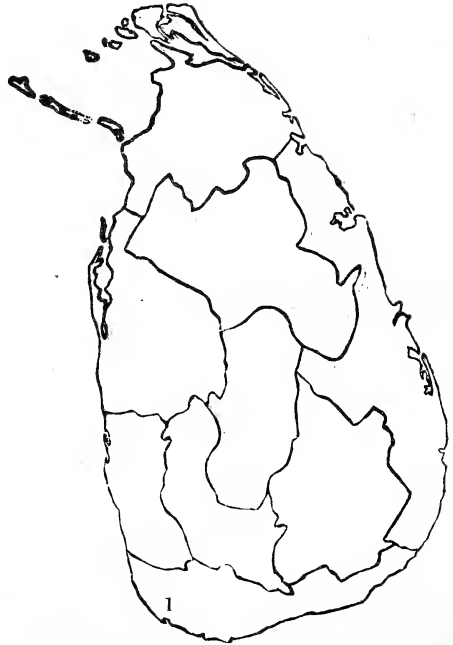
FIG. 9.

NYSSORHYNCHUS MACULATUS.

1 Peradeniya ; 2 Pundalu-oya

FIG. 10.

PYRETOPHORUS JEYPORENSIS.



1 Galle

CYSTICERCUS CELLULOSÆ IN A TAMIL.

By Albert J. Chalmers, M.D., F.R.C.S.,
Registrar of the Ceylon Medical College.

CYSTICERCUS CELLULOSÆ has not, as far as I know, been recorded in a human being in Ceylon, and therefore these few notes may be of interest.

A Tamil woman, aged forty years, died with obscure symptoms in the General Hospital, Colombo. On making the post-mortem a few well-developed Cysticerci were found lying in the intermuscular septa of the pectoralis major muscle on both sides of the body. On examining the brain a considerable number of Cysticerci were found in the gray matter of the cortex, in the choroid plexus of the lateral ventricles, in the third ventricle, in the brachium conjunctivum, and in the pons.

Many other muscles and all the other organs, except the eye, were examined, but no more cysts were found.

No adult tapeworms were found in the intestines, which were inflamed and ulcerated.

Remarks.

The two common bladder worms which are found in men are Cysticercus cellulosæ and the Echinococcus. The latter is not indigenous to Ceylon, and the only case I am acquainted with was a Boer prisoner of war, who suffered from hydatids, and was treated at Diyatalawa Camp by Dr. Garvin, Senior Surgeon to the General Hospital, Colombo.

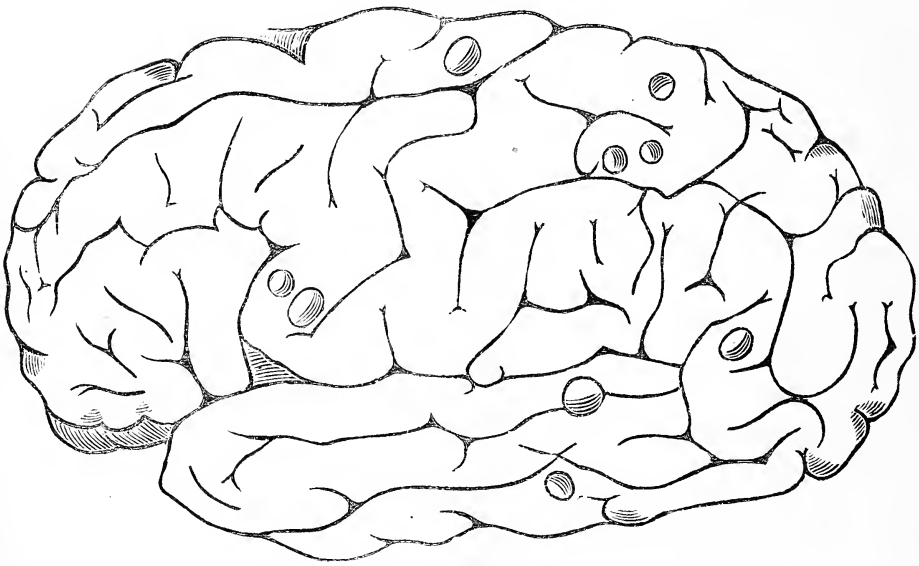
The tapeworms at present known to affect man in Ceylon are *Tænia solium* and *Tænia saginata.*

The *Cysticercus cellulosæ* is very common in Europe; in fact it was said to be found as commonly as in 2 per cent. of all post-mortems in certain parts of Germany (Virchow). Its most common site is in the brain, and after that in the muscles.

The most common place in the brain for it to be found is in the membranes and cortex, and after these in the corpora striata and optic thalamus, the fourth ventricle, and lastly in the choroid plexus.

It is not common in the cerebellum, and the brachium conjunctivum or superior cerebellar peduncle is not mentioned, nor is the pons. Of the muscles, the pectoralis major is most common.

The eye was not examined in this body. In Europe cysticercus of the eye is not uncommon, but in Ceylon, according to Dr. W. H. de Silva, the Ophthalmic Surgeon to the General Hospital, Colombo, it has not been found.



Right Cerebral Hemisphere of a Tamil woman, showing cysts of *Cysticercus cellulosæ*.

NOTES ON CEYLONESE APHIDES.

By H. SCHOUTEDEN.
(*Brussels.*)

With Plate.

THROUGH the kindness of Mr. E. E. Green, of the Botanical Gardens of Peradeniya, I was able to examine a few Ceylonese Aphides, amongst which I found very interesting forms.

Of the species, four in number, which, according to the wish of Mr. Green, I here describe, two are new to science : *Ceratopemphigus zehntneri* and *Lachnus Greeni;* the others are already described forms : the *Siphonophora artocarpi* of Westwood and *Oregma bambusæ* of Buckton. As was already to be seen on the figures given by Westwood in the Trans. Ent. Soc., Lond., the first is not at all a *Siphonophora*, nor even a Siphonophorid (Macrosiphid). As to *Oregma bambusæ*, B., it is a very peculiar species, the description of which, however, is very insufficient, and the figures, in the Ind. Mus. Notes, rather fantastic !

GREENIDEA, n. g.

For the reception of the *Siphonophora artocarpi* of Westwood it seems to me necessary to erect a new genus, which I take much pleasure in naming GREENIDEA. This may be characterized as follows :—

" Body elongate, furnished with numerous strong bristles on the whole upper surface, including the cornicles ; these very long, nearly cylindrical, slightly constricted at base. Cauda very short, but well marked. No frontal tubercles, vertex nearly plain. Antennæ six-jointed, the sixth joint furnished with an appendix longer than basal part. Anterior wings with the cubitus twice forked ; second oblique vein peculiarly curved ; posterior wings with two oblique veins removed at base ; wings carried vertically at rest."

Greenidea will be easily separated from the other genera of Aphidinæ by the strong bristles which cover the body and cornicles, and by the shape of these and the cauda.

I.—GREENIDEA ARTOCARPI (Westw.).

Siphonophora artocarpi, Westwood, Trans. Ent. Soc., Lond., 1890, p. 649, pl. XXI.; *l.c.*, 1891, p. 413.

Apterous Viviparous Female (figs. 1 and 2).

Body elongate, ovate, bright pale green, with the cornicles dark brown (pale brownish on immature specimens) and the eyes crimson. Upper surface furnished with transverse rows of long and rigid bristles arranged as follows : on the cephalothorax, between the antennæ, two bristles (nearly equally distant from antennæ as from each other) on a transverse line between anterior margin of eyes, a row of six and two rows of four and six beneath eyes ; on mesonotum, near the anterior margin, in the middle, two somewhat shorter bristles, then an anterior submarginal row of six strong setæ, and on posterior part six ; on the following segment an anterior row of eight bristles ; the following abdominal segments with irregular rows of bristles ; between the cornicles an arcuate row of four, another posterior of three, two on the last segment ; caudal segment with numerous bristles somewhat less rigid and paler.

Front nearly flat, scarcely elevated at base of the frontal bristles ; a very obsolete median longitudinal impression. No frontal tubercles. Antennæ longer than the body, up from apical part of third joint dark ; first and second joints short and thick ; third longest, fifth nearly half as long as third, fourth shorter than fifth, sixth equal to fourth, seventh subequal to third or even longer ; thus the relative lengths are : 1·5, 1·, 12·, 5·, 6·5, 5·, 11 (12) ; joints three to seven, imbricated, with some bristles ; a fovea at tip of fifth joint, sixth with (at base of seventh) a large fovea and some smaller. Rostrum extending distinctly beyond posterior coxæ ; last joint short and black. Eyes of large size, of dark grenat colour, or crimson ; furnished with a well-separated appendix. Legs of moderate size, moderately pilose, the tibiæ more so and with dark tips, as are also the feet.

Cornicles dark brown, very long (at least as long as half the body), nearly cylindrical, but slightly narrower at base, then thicker and gradually narrowing to the tip, when they are scarcely expanded ; they are covered with reticulate imbrications, which towards the apex bear very short bristles ; like the remainder of the upper surface, they are furnished with scattered long bristles.

The tail is very short, presenting also transverse elevations with short bristles, and the long bristles already described.

Long.: 1·8–2·15 mm.

Mr. Green sent to Professor Westwood a description of the colour taken from the living specimens, which I transcribe here : "The larvæ and pupæ are of a bright pale green colour ; the honey-secreting tubes, cornicles, or nectaries are pale brownish, and the eyes crimson. The imago state is also bright green immediately

after the final moult, but soon darkens to brownish green; with the thorax and bands across the abdomen brown; the eyes are bright crimson. The antennæ, legs, and honey tubes are brownish, and the space below the eyes is brown.

Winged Viviparous Female.

Head furnished with three large ocelli; two at internal anterior margin of eyes, the third middle on the front. Eyes like apterous female. Front with a median impression, and very slightly prominent at base of antennæ. Antennæ with the first joint slightly larger than the second; third the longest, more than twice the length of fourth, fifth slightly longer than fourth, (sixth) shorter than fourth, (seventh) shorter than third (sometimes nearly equal); relative lengths: third joint = 12–13·3; fourth joint = 4·8–5·6; fifth joint = 5·5–6; sixth joint = 4·2–4·3; seventh joint = 7·5–7·12; third joint with numerous foveæ (fig. 3); third to seventh imbricated; all the joints with some bristles; fifth with a subapical fovea; (sixth) with foveæ at base of (seventh). Head and pronotum with somewhat rare bristles; mesonotum with the bristles more numerous on posterior part; dark brown. Abdomen fasciated with brown, not setose. Cornicles dark brown, nearly cylindrical, longer than half the body; tail short; caudal segment convex.

Anterior wings longer than the body, elongated, with dark veins clouded at tip; stigma elongated, first oblique vein straight, second peculiarly ⌒ curved; cubitus not reaching the cubital vein (*sensu* Lichtenstein) usually twice forked, but sometimes the outer branch is not forked.

Inferior wings longer than the body; costa subparallel to the margin; two oblique veins, not parallel, remote at base.

Long.: 1·70–1·85 mm.; wing 2·20–2·35 mm.

Greenidea artocarpi feeds in Ceylon on *Artocarpus integrifolia* and *Onesma ferrea*.

Mr. Green observed that "when alarmed the insects suddenly dropped from the leaves to the ground. They are very active and walk rapidly."

N.B.—The drawings which accompany the description given by Westwood are not at all exact; compare, for example, the antenna he represents (fig. 9 of his plate) with the one I here figure! So he draws three short joints at base in place of two only. Owing to a remark of Mr. Green, Westwood in his second notice figures rightly the eye of the species (the drawing here reproduced was of too small size to give the exact proportion of the appendix).

II.—Lachnus Greeni, sp. n.

Body somewhat elongated, produced anteriorly and posteriorly, dark, entirely covered (including legs and antennæ) with numerous fine bristles carried on small granules.

Vertex convex, with a median longitudinal impression. Eyes dark grenat or obscure red-brown, with posterior appendix obtuse and somewhat obsolete. No frontal tubercles. Antennæ (fig. 4) about equal to one-third of the body; first and second joints stout, of equal length ; third the longest, fourth nearly equal to half third, fifth longer than fourth, (sixth) hardly longer than or equal to fourth, (seventh) equal to half second, thus, 1·, 1·, 3·75, 1·7, 2·, (1·8), (0·5), — or 1·, 1·, 3·5, 1·5, 2·, (1·7), (0·5) ; fifth joint with a large subapical fovea and another before this ; sixth with a large fovea and several smaller at tip ; seventh indistinctly annulated.

Rostrum reaching posterior coxæ, somewhat prominent at base under the vertex, dark, last joint black. Legs of moderate size densely pubescent, specially the feet ; tibiæ and tarsi with dark tips.

Segmentation of abdomen obsolete ; the segments furnished on each side with a small obtuse tubercle (more conspicuous in the young specimens). Cornicles cone-shaped, half the body length, truncated at tip, with a prominent apical margin, pubescent Tail not separated from body, obtuse rounded, furnished with minute tubercles between which are other thicker ; apical part with the bristles somewhat longer and denser, directed backwards.

Length of the body : 2·20–2·50 mm.

Of this new species I have seen only the viviparous apterous form, which Mr. Green collected in the nests of an ant, *Crematogaster Dohrni*, For., on the roots of an undetermined *Cryptomeria*, in Peradeniya.

III.—Oregma bambusæ, Buckt.

This form was first described some years ago by J. B. Buckton, in the Indian Museum Notes. But his description is unusually incomplete, and the drawings reproduced in his paper are not at all exact: thus, the tarsi are represented with the two joints of equal length (a fact which would be most interesting amongst Aphides !) when in reality the first is much shorter than the second !

Owing to these bad descriptions and figures probably the genus was not recognized by the well-known entomologist of the Proefstation in West Java, Dr. Zehntner, when he described his new genus *Ceratovacuna* (Archief voor de Java-Suikerindustrie, V.), for the reception of *C. lanigera*, Zehntn., a predaceous Aphid on *Saccharum*, of which he has given an accurate description with

fine plates. As I was able to verify on specimens of *Ceratovacuna lanigera* kindly sent to me by Prof. Busse, *Ceratovacuna* must be treated only as a synonym of *Oregma*, although the two species *O. bambusæ* and *O. lanigera* are very distinct forms. The description given by Zehntner is, I may say, a model in its kind, and it is therefore not necessary that I here describe again *O. lanigera*, of which I figure only the antenna of winged female for comparison with *O. bambusæ*.

The synonymy of the genus is thus :—

OREGMA, Buckton, Ind. Mus. Notes, III., p. 87.

Ceratovacuna, Zehntner, Arch. voor de Java-Suikerindustrie, V., p. 553 (1897).

(1) *O. bambusæ*, Buckt., Ind. Mus. Notes, III., pp. 87 and 108.

(2) *O. lanigera*, Zehntner, Arch. Jav. Suikerind, V., Aflev. 10, p. 553 (1897) (*Ceratovacuna*); Mededeel van het Proefstation voor Suikerriet in West Java, No. 49, or Arch. Jav. Suik.-ind., VIII., Aflev. 20 (1900) (*Ceratovacuna*).

Apterous Viviparous Female.

Body broadly ovate, rather convex ; the younger specimens are more elongated, oval ; of a dark grayish colour, somewhat pulverulent, a tuft of white wool at end of abdomen.

Cephalothorax very distinctly separated. Segmentation of the abdomen distinct on larvæ only.

Front furnished with two teeth-like processes, which are hardly more remote from each other than from basis of antennæ ; the most developed females have the processes smaller, nearly so long as the first antennal joint. Larvæ and young specimens present them much longer, nearly of equal length to the cephalothorax, very distinctly curved. Eyes of very small size.

Antennæ of equal length as the cephalothorax (or slightly longer); the fifth joint and apex of fourth black or dark ; they are inserted on short frontal tubercles. First joint hardly longer than the second, and slightly broader ; second slightly constricted at base ; third, the longest, so long as the following two united, much longer than the two preceding, nearly cylindrical ; fourth nearly so long as half the third ; fifth slightly longer than fourth, after middle gradually narrowing, with a short appendix. (Buckton figures the fourth joint longer than the third.) Rostrum very short.

Legs robust, posterior tibiæ long ; tarsi two-jointed, first joint very short, second much longer (the first is therefore not so long as the second, as Buckton draws it !).

Dorsum of abdomen furnished with transverse rows of well-developed pili, longer and more numerous on apical end. No distinct tail.

Length of the body : 2·5–3 mm.

Winged Female.

Body black, not woolly (*teste* Green, in Buckton); abdomen broad, somewhat domed (but damaged in the few specimens I could examine).

Front furnished with two very short teeth, of equal distance from antennæ and from each other. Eyes very large, presenting a well-marked appendix ; three large ocelli.

Antennæ (fig. 5) so long or slightly longer than head and thorax united, five-jointed ; the two basal joints broad and stout, the first slightly longer than the second ; third very long, distinctly longer than the breadth of the head ; fourth not longer than $\frac{1}{3}$ of third ; fifth (with its appendix) distinctly shorter than fourth, the appendix nearly equal to $\frac{1}{5}$–$\frac{1}{4}$ of its length ; joints 3–5 furnished with numerous elevated rings, between which are others, very fine (3–4 between two elevated rings) ; of the first there are on third joint 45–50 rings, on the fourth 12–16, on the fifth 8–13 (the appendix without any) (fig. 5).

Pronotum transverse, short, slightly broader than head (including eyes), somewhat paler coloured. Mesothoracic lobes shining. Legs of moderate size, remotely pubescent ; second joint of the feet long, first much shorter.

Anterior wings longer than the body, at rest carried flat on the body, broadest after the middle. Subcostal vein and margin nearly parallel ; stigma dark, brownish dark punctured, with darker inner margin ; cubitus indistinct at base, forked before the two-thirds of its length, the outer branch longer than the inner one ; the length between apex of radial and outer branch of cubitus is nearly equal to one-third of the distance between the apices of the two cubital branches ; the two oblique veins are united at base.

Posterior wings with the subcostal vein subparallel to the margin (except near the usual tooth-like process); two oblique veins, rather distant at base, divergent.

Long.: 2·50–2·60 mm.; wing : 3–3·10 mm.

Obs.—One of my specimens presents the outer branch of the cubitus forked after middle of its length.

Oregma lanigera, Zehntn., is a very distinct species, of smaller size (winged form = 1·60–2·15 mm.; wing = 2·50–2·80 mm.), less robust, otherwise coloured, covered with wool ; the antennæ are

also quite different in the two species (see figs. 5 and 6); and the radial is slightly more remote from outer cubital branch.

O. bambusæ feeds in Ceylon on *Dendrocalamus giganteus* and in India on *Bambusa arundinacea*.

Ceratopemphigus, n. g.

Amongst the Aphides which Mr. Green submitted to me I found a form, apparently new, with the mention "from large foliate galls on undetermined shrub," a specimen of which was also sent, which I here figure (fig. 9). This species was only represented by the winged female and its nymphs, but its characters are sufficient for considering it as a new one, belonging to an undescribed genus. This I have named *Ceratopemphigus*, as it has some resemblance to the *Ceratovacuna* of Zehntner. I take great pleasure in naming the species after my esteemed colleague, Dr. L. Zehntner, from whom we have such interesting reports on Aphides of Java.

The genus may be characterized as follows (from the winged form): "Head furnished with two divergent short and obtuse teeth (winged female; they are very probably longer in the apterous form, as in the case of *Oregma*). Antennæ six-jointed, sixth joint with a short appendix; joints 3 to 6 with conspicuous rings in the winged form. Eyes with the appendix hardly developed. No cornicles. Cauda obtusely rounded. Anterior wings with the two oblique veins arising from the same point; the cubitus not forked, obsolete at base, but directed towards the common base of the oblique veins. Posterior wings with the cubital vein apparently trifid at apex, the oblique veins springing from the same point."

IV.—Ceratopemphigus Zehntneri, sp. n.

Winged Viviparous Female.

Head (fig. 7) transverse; vertex slightly convex, furnished with two obtuse stout teeth, the distance between which is shorter than from basis of antennæ. Eyes black-brown, large, with an obtuse convex appendix posteriorly. Three ocelli: one on each side near anterior margin of eye, the third median, beneath the frontal teeth. Antennæ (fig. 7) longer than one-third of the body, robust; first joint short, slightly longer than or equal to the second; third the longest; fourth longer than half of third; fifth subequal to fourth; sixth (without the appendix) slightly longer than fourth; the appendix stout, half the length of second joint: *e.g.*, 1·–1·5, 1·, 4·–4·5, 2·5, 2·5, (2·5), (0·5); second joint narrower at end, the following joints subcylindrical; third with 8–10 conspicuous elevated rings; fourth with 4–6; fifth with 4; (sixth) with 2–4

and an apical fovea; between these rings are obsolete annulations: bristles rare. Rostrum extending to the middle coxæ. Thoracic lobes dark brown, a pale median line. Legs infuscated, with some bristles. No cornicles; tail obtusely rounded, furnished with some setæ.

Anterior wings (fig. 8) longer than the body; stigma elongated, brownish; veins dark; first and second oblique springing from same point of cubital vein, clouded at base, the first slightly curved, second nearly straight; cubitus not reaching the cubital vein (if it did, it would reach the common base of the oblique veins); radial rather long, very slightly curved.

Inferior wings (fig. 8) with two oblique veins, springing from same point, the second vein long and curved; the cubital vein therefore apparently trifid.

Length of the body: 1·75–2·35 mm.; wing: 2·60–3 mm.

Nymph.

The wing-cases are dark. Vertex with two conspicuous teeth, obtuse and rather stout, divergent, nearly contiguous at base, separated by a small prominence; the common base somewhat elevated. Antennæ six-jointed: first and second joints short, of equal length; third equal to (sixth) or slightly longer; fourth longer than half of third; fifth equal to fourth; seventh short, equal to half of second: 1·, 1·, 2·5, 1·5, 1·5, (2·5), (0·5).

Gall (fig. 9).

I figure the specimen of gall* I received from Mr. Green; it is a large one, measuring 44 mm. in diameter, springing from the leaf. The shrub is possibly a *Pistacia*.

EXPLANATION OF PLATE.

Fig. 1.—Head and antenna of *Greenidea artocarpi*, apterous ♀.

Fig. 2.—Cornicles and tail of *Greenidea artocarpi*, apterous ♀.

Fig. 3.—Antennal joint of *Greenidea artocarpi*, winged ♀.

Fig. 4.—Antenna of *Lachnus greeni*, apterous ♀.

Fig. 5.—Antenna of *Oregma bambusæ*, winged ♀.

Fig. 6.—Antenna of *Oregma lanigera*, winged ♀.

Fig. 7.—Head (from below) and antenna of *Ceratopemphigus zehntneri*.

Fig. 8.—Wings of *Ceratopemphigus zehntneri*.

Fig. 9.—Gall of *Ceratopemphigus zehntneri*.

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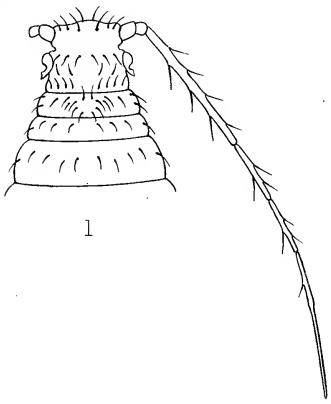
* Other galls observed on the shrub were considerably larger than the one sent to Mons. Schouteden.—E.E.G.

SPOLIA ZEYLANICA.



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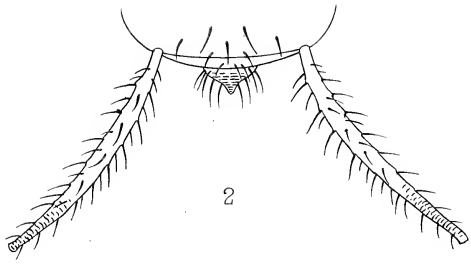

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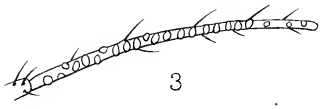

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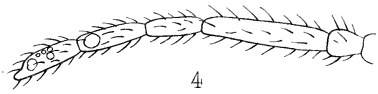

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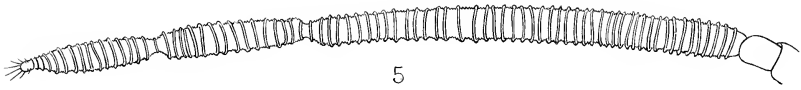

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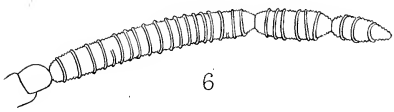

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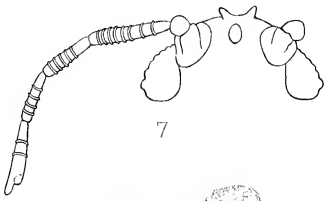

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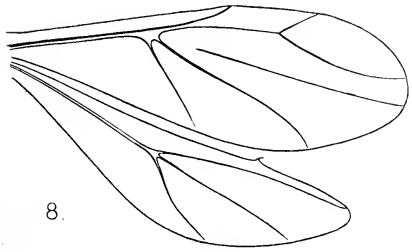

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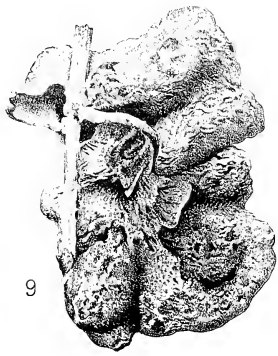

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E. Menger del.

West, Newman lith.

CEYLONESE APHIDES.

NOTES.

1. *Irregularly developed Crystals of Zircon* (sp. gr. 4·0) *from Ceylon.*—Mr. L. J. Spencer, M.A., has recently described (Min. Mag., vol. XIV., No. 63, pp. 43–48, 1904) some very irregular crystals of zircon from gem-bearing gravels forwarded by the Director of the Mineralogical Survey. These, together with more usual types, are abundant in some of the gemming districts, being derived no doubt from granitic rocks of the Balangoda group; the best specimens of the irregular zircons are from the Bambarabotuwa valley and Walaweduwa. The specific gravity of the irregular crystals varies from 4·0 to over 4·5, the darker coloured crystals being less heavy and the lighter coloured more heavy.

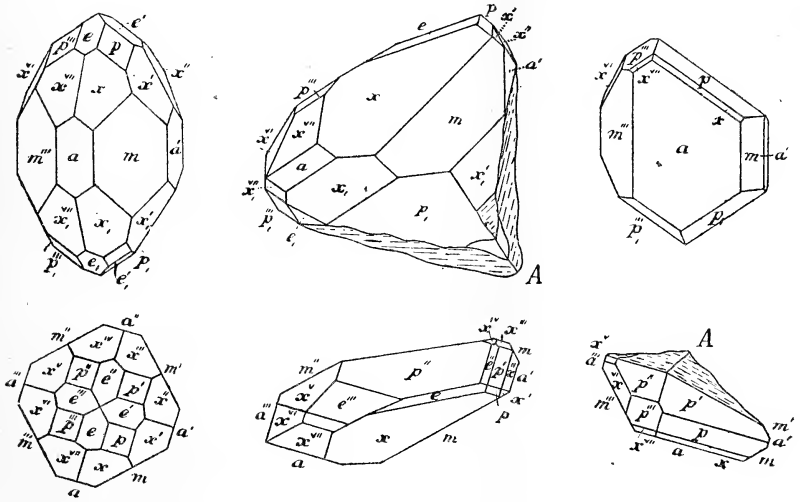

Fig. 1. Ideal development.

Fig. 2. Actual crystal.

Fig. 3. Actual crystal.

Zircon from Ceylon (Clinographic drawings and plans.—L.J.S.).

The accompanying figures (figs. 2 and 3) are intended to give an idea of the shape of two of the crystals, while fig. 1 represents an ideally developed crystal with the same forms. The forms present are: a (100), m (110), e (101), p (111), and x (311). A peculiar feature presented by almost all the crystals of low specific gravity is that on one side they show an area of deeply striated and

stepped surfaces. These surfaces usually lie in the principal zones of the crystal, and meet in a central point (A, in figs. 2 and 3) to form a pyramid, which in most crystals has a quite flat base parallel to a (100) or m (110). The six-sided type shown in fig. 3 is very usual; such crystals do not at all suggest a zircon at first sight.

At the centres (A) of the striated areas the crystals are pale in colour, transparent, and possessed of a brilliant adamantine lustre. Away from this point the colour gradually shades off into brown, and the transparency and lustre diminish.

Further detailed examination showed that the crystals consist mainly of a dark brown zircon of specific gravity 4·0, which is optically uniaxial, usually intergrown with a lighter coloured variety of higher specific gravity which is optically biaxial; the dark variety when heated changes to green in colour and becomes biaxial; the pale variety when heated increases in density, but shows no optical changes. The two varieties are identical in crystalline form.

It seems, therefore, that there are at least three classes of zircon :—

- α Those of sp. gr. 4·0, which do not increase in density when ignited;
- β Those of sp. gr. 4·7, also not increased in density when heated.
- γ An unstable form of sp. gr. about 4·3, which when ignited is increased in density to 4·7.

Zonal intergrowths of these varieties account for the properties of zircons with intermediate characters.

A. K. COOMARASWAMY.

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2. *Ornithological Records for 1904.*—The following notes on birds acquired during the past year under rare or peculiar circumstances will be of interest in themselves and useful for future reference. In one case, that of the Short-eared Owl, the fact of its occurrence in Ceylon will be new to most ornithologists, although it has been known here since 1891.

A.—Migratory Birds.

The captures are recorded below in chronological order :—

(1) A young male Sociable Lapwing (*Chettusia gregaria*) was shot near the Havelock Racecourse on 5th January and was purchased for the Museum, where it has been mounted and exhibited for the first time. The Museum previously possessed one

skin from Colombo, presented by the Ceylon Branch of the Royal Asiatic Society in October, 1873. Legge (Birds of Ceylon, p. 960) records this bird as having been procured only twice in Ceylon, namely, by Mr. Bligh on the Galle Face at Colombo during the cool season about the year 1870, and by Mr. MacVicar in the same spot on 17th October, 1873. The latter specimen is presumably the one which was presented in that year to the Museum. None has since been recorded locally until this year. Dr. Blanford (Fauna Brit. Ind., Birds, vol. IV., p. 232) describes it as "a migratory bird breeding in Eastern Europe and Central Asia and visiting North-Eastern Africa and North-Western India in winter." It occurs in flocks from four or five to fifty or sixty in number, arriving in India about the beginning of October and leaving about March. The occurrence of a stray example in Colombo is always noteworthy.

(2) On 12th June another example of the Lesser Frigate Bird (*Fregata ariel*), an oceanic species already referred to in this journal,* was captured alive at Uplands, Mutwal, and sent to the Museum by Mr. J. H. Bostock. It arrived, as usual, in an exhausted condition and died soon afterwards. It was a young male: the skin has been preserved.

(3) A male Indian Pitta† (*Pitta brachyura*), in perfect plumage, was taken alive at Kollupitiya, but soon died, and was then brought to the Museum on 29th September, where it has been mounted.

(4) On 30th October a male specimen of the Banded Crake (*Rallina superciliaris*), variously known as the Brown Rail or the Ruddy Rail, flew into a bungalow at Maradana and was caught and given to the Museum. Another example was taken shortly afterwards under similar conditions at Bambalapitiya, and a third was sent from Darley House. It is a common migratory bird, and, like the Pitta, it is one of those which occasionally crash into bungalows in the heat of their migratory flight, sometimes coming into violent and fatal collision with the walls of buildings.

(5) At the end of October and during the month of November several Malay Bitterns (*Gorsachius melanolophus*, a handsome, not uncommon north-east migrant) were taken alive in the roads and houses of Colombo. One of them flew into the ball-room at Queen's House at night, and was kindly forwarded to the Museum by His Excellency the Governor on 24th November. Another was caught while running about the Fort, pursued by crows, and was sent up by Mr. James Dorman.

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* Vol. I., Part III., 1903, p. 78, where it was named, in error, *Fregata aquila*.
† See *Spolia Zeylanica*, Part III., p. 78.

They are very wild birds, feeding on fish, crabs, and worms, and they do not take at all kindly to captivity.

(6) A Harrier, called Montagu's Harrier (*Circus cineraceus*), was shot in the Ratnapura District and purchased by the Museum in December. This species, like the three other Harriers—Marsh, Pied, and Pale—belonging to the fauna of Ceylon, is a north-east or winter or cool season migrant to Ceylon, where it arrives about October, leaving again in April. It is rarely seen in the middle of the Island, *i.e.*, in the hill region, although Mr. F. Lewis (Notes on the Ornithology of the Balangoda District, Journ. Ceylon Asiat. Soc., vol. VIII., 1884, p. 278) has recorded it from Balangoda. According to Legge (*op. cit.* p. 14) it first concentrates in the Jaffna Peninsula and adjacent islands, and then spreads down both sides of the coast, but apparently does not wander into the interior. Its occurrence in Ratnapura is therefore exceptional, and this is the second specimen acquired by the Museum.

The Pied Harrier referred to above (*Circus melanoleucus*) is the rarest of the Ceylon Harriers. The first specimen obtained by the Museum was shot near Angurantota on the road to Neboda in the Kalutara District in February, 1891. From a manuscript note left by Mr. A. Haly it appears that this bird and its mate had been noted for some years frequenting the same paddy field. A second skin was purchased in 1898.

(7) A Pale Harrier (*Circus macrurus*) was caught alive on board a steamer about seventy miles from Colombo, and was sent by Mr. W. Jackson Jones to the Museum on 5th November. It had apparently lost its bearings. The skin of another specimen shot at Ratnapura was received at the Museum in a damaged condition on 25th November.

(8) The Marsh Harrier (*Circus æruginosus*) is the commonest of the Harriers in Ceylon. It is not uncommonly seen in Colombo in the cool season, and is sometimes pursued by crows on the wing. Two skins from Gampola were sent in December by Mr. W. W. Stevens.

(9) During the last fortnight of December and in the following January (1905) a most interesting visitor appeared in some numbers in Colombo (Galle Face Battery and Cinnamon Gardens). This was the Short-eared Owl (*Asio accipitrinus*), a bird of wide distribution, but according to Dr. Blanford (Fauna. Brit. Ind., Birds, vol. III., 1895, p. 272) not hitherto recorded from Ceylon. It had been recorded from Ceylon, though not in a manner accessible to ornithologists, by Mr. A. Haly (Administration Report, Colombo Museum, 1891). It was not included in Legge's Monograph on the Birds of Ceylon (1880).

The first specimen obtained here was shot by the Museum Taxidermist (Mr. H. F. Fernando) in Jaffna in December, 1891. In 1896 the skins of a male and a female, also from Jaffna, were purchased, and in February, 1897, one was shot by Mr. Thomas Farr at Bogawantalawa.

The 1904 invasion has been very noticeable, the birds cropping up in considerable numbers, ten or more specimens being accounted for in Colombo alone. One was shot at Nuwara Eliya. Perhaps this exceptional migration is connected with the steady blowing of the monsoon, coupled with the failure of the rainfall in South India.

The term "short-eared" refers to a pair of short tufts, each consisting of two or three feathers only, over the facial disks. These tufts can be erected and depressed. When depressed they are almost indistinguishable. In the living bird they are to be seen erected during the early forenoon.

(10) An Indian Crested Falcon or Black-crested Baza (*Baza lophotes*) shot on the Dea Ella estate, Galagedara, in October, 1903, has been purchased this year. It is a rare migrant. The first specimen, a damaged skin, was deposited here at the opening of the Museum in 1877; two more were purchased in Kandy in 1900 and have been placed on exhibition. The present specimen is the fourth to be acquired by the Museum, and is a perfect skin.

B.—Resident Birds.

Two birds acquired by the Museum during 1904 deserve special mention on account of their exceptional character and rarity.

(1) A semi-albino of the White-browed Bulbul (*Pycnonotus luteolus*, formerly *Ixos luteolus*) has been given to the Museum by Mr. W. W. Stevens. The plumage is coloured almost uniformly a pale canary yellow. The prevailing colour of the upper plumage of the normal bird is a dull green or grayish-green. I have recently seen a perfect albino of the Rose-ringed Paroquet, that is to say, having pink eyes as well as decolorized plumage, in which the latter was a uniform rich canary yellow except for the red collar, the normal colour being a bright green. On the other hand, the albinos of the Crow and of the Peafowl are white.

(2) The skin of a Ceylon Bay Owl (*Photodilus assimilis*) from Kurunegala, said to have been shot in August, 1903, was purchased in Kandy. This species is one of the rarest existing Owls, having only been found in the Ceylon hills (*cf.* Blanford, *op. cit.*, vol. III.,

p. 270), where it is seldom seen. The specimen now referred to is the third in the Museum. The first came from Kadugannawa, the second from Nuwara Eliya.

A. WILLEY.

January, 1905.

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3. *Rambling Notes by the Way.*

A.—At Sea, off the Maldives (November).

Bird visitors, from the neighbouring land, are constantly coming and going, on the voyage from Europe, but *Spolia Zeylanica* takes no account of anything outside of Ceylon waters.

Minicoy Island (actually one of the Laccadive Group, though geographically nearer the Maldives) marks our arrival in the area related to Ceylon.

Soon after sighting the Minicoy lighthouse, a Paradise Fly-catcher (*Terpsiphone paradisi*, Linn.) boarded the steamer and was flying about the rigging for some time. It was a male in full plumage, and formed a very conspicuous object. It was eventually captured by one of the stewards and placed in a small cage, in which it found its long tail sadly in the way. I was consulted as to the proper food to give it, but succeeded in persuading the man that it would be impossible to keep it alive on board ship, and arranged for its liberation on shore when we reached Colombo.

A small Warbler of sorts also took a free passage from Minicoy to Colombo.

A school of Dolphins accompanied us for several miles, playing about just under the bows of the boat. Watching these from above, one could not avoid astonishment at the ease with which they kept their exact distance from the sharp nose of the ship. They appeared to progress without any effort and without appreciable movement, just as though they were being pushed along by the vessel.

When within sight of Colombo I was surprised to see two large Whales. One of them passed within thirty yards of the ship and was mistaken for a large log of wood floating by, until it threw up a jet of spray from its respiratory orifice.

B.—Anuradhapura to Jaffna (December).

Condemned to the miseries of the bullock coach, the jolting of which made reading impossible, I had recourse to noting the signs of life by the roadside. As heavy rain was falling during the greater part of the time these were not abundant.

The common Paddy Heron or Pond Heron (*Ardeola grayi*) was numerous and extraordinarily tame. It would remain on

its perch until the coach was within a few feet of it, and then shift its position by a few yards only. It is a striking object-lesson in protective coloration to see a bird which looks conspicuously and almost wholly white when flying become a dull grayish-brown object when the wings are closed. When one of these birds pitched, though within a few yards of the observer, it became practically lost to view, and required careful scrutiny before its position and form could be made out. But from the protective point of view, why does it make itself so conspicuous when on the wing? What are its enemies? Presumably hawks and eagles. It has a slow and somewhat heavy flight, and could not hope to escape from the rapid tactics of a bird of prey. Possibly its apparent unwillingness to take extended flights results from an intuition that it would thus more certainly expose itself to attack. By flashing out brilliantly white at one moment and disappearing the next it would probably confuse its enemy.

Wanderoo monkeys (*Semnopithecus priamus*) were frequently seen seated unconcernedly on the trees by the roadside, watching the passage of the coach.

At Rambakulam resthouse I was amused to see an ingenious self-supporting aquarium. In the outer globe of a large cocoanut oil lamp the resthouse-keeper had confined half a dozen tank-fish, the small receptacle for the oil being suspended almost level with the surface of the water. I noticed that the fish looked very plump and well fed, and was told that they lived upon the bodies of the many insects that fell into the water when the lamp was lit each evening.

At night the approach to swampy ground was heralded by a chorus of harsh notes, presumably the call of *Rana tigrina*. Another more isolated frog-call was something like the initial yelp of a jackal.

The first bird-call noticed about dawn was the well-known "Jock Joyce" of the Jungle Fowl, followed shortly by the musical cry of the Oriole. As I was walking ahead of the cart in the still early morning a pair of Hornbills (*Lophoceros gingalensis*) crossed above the road with their peculiar undulating flight. Three half-grown Jungle Hens scratched for food in the ditch close by, regardless of my presence.

As we neared Elephant Pass I caught sight of a queer creature shambling off into the scrub, which, for the moment, I mistook for a gigantic tortoise, but then recognized it as a Scaly Ant-eater or Pangolin (*Manis pentadactyla*). I had never before seen one of these beasts in its natural haunts, and regretted that it was on view for such a short time.

A Pied Kingfisher (*Ceryle varia*) hovered in the air with rapidly beating wings, then fell like a dart perpendicularly into the shallow water beside the causeway at Elephant Pass. It was up again in a moment, having apparently failed in its object, and flew off to its perch. Do these birds transfix their prey? The action certainly suggests this mode of capture.

Papilio hector was the most prominent insect on the North road. It was certainly the commonest butterfly in Jaffna. I could generally count two or three in the field of vision at any time. On a former visit to Jaffna, in the month of March, a similar abundance of this species was noticeable. They were even flying past and over the steamer in considerable numbers all the way between Paumben and Jaffna. Its food plant was not conspicuous. I do not recollect having observed a single plant of *Aristolochia* during my journey or my stay in Jaffna.

Of flowers, *en route*, there was a marked scarcity. Most of the trees seemed to be in fruit. The *Cassia fistula* carried young pods, though an occasional tree was still in partial flower. A species of *Capparis* bore vivid crimson balls. The climbing lily, *Gloriosa superba*, formed the only note of colour until we neared Elephant Pass, when a *Clitoria* showed heavenly splashes of blue on the shrubs over which it clambered.

C.—Jaffna (December).

Here the object of my visit was to investigate a plague of caterpillars that was devastating the paddy fields. I quite expected that the insect would prove to be a species of *Leucania*, but when the moths commenced to emerge in my breeding cages they confounded me by appearing in the garb of *Spodoptera mauritia*, Boisd. *Spodoptera* is a monotypic genus represented by this single species. It has a wide geographical distribution, being recorded from West Africa, Mauritius (whence it takes its specific name), Shanghai, and throughout the Oriental and Australian regions. But the caterpillar appears to have been unobserved hitherto. It has certainly never attracted attention as an insect pest.

The caterpillars had evidently been present in vast armies; but the heavy rains during the last few days had greatly reduced the number. Crows, too, were busily engaged in thinning the ranks.

This abnormal increase appears to result from a failure of the usual rains in October and November. The natural checks of such caterpillars are, to a great extent, fungal and bacterial diseases which are unable to develop in a period of drought. These caterpillars had travelled for considerable distances,

devouring the grass and grain crops in the line of their march. They had been observed crossing roads and paths in close array, and might then have been headed off and trapped in deep ditches. *Leucania unipuncta* has a similar migratory habit in North America and parts of Australia. It is there known as the "Army Worm."

While moth-hunting one afternoon I watched a common hornet (*Vespa cincta*) capture and carry off a small Pyralid moth. It settled on a branch, supporting itself head downwards by its last pair of legs only, using the others to manipulate the insect. The wings and legs of the moth were shredded off and the rest of the body chewed up into a pellet, which was then carried off, doubtless to feed the grubs in the nest.

On board the ss. Lady Havelock off Jaffna a considerable number of moths (principally small Noctuids) were attracted by the lights of the ship, though she lay more than a mile in a direct line from the nearest land.

E. ERNEST GREEN.

December, 1904.

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4. *Python from Borneo.*—Mr. John Hagenbeck recently received a large python from the Malay Archipelago (probably from British North Borneo) which laid a batch of eggs after its arrival in Colombo and incubated them herself with success, some thirty or forty young hatching out in due course.

The following notes have been kindly supplied by Mr. Hagenbeck :—

Colombo, January 20, 1905.

A gigantic python which arrived here last year from British Borneo *viâ* Singapore laid about one hundred eggs on the 28th October, almost filling the box in which she was kept. On the following morning she had collected the eggs, by skilful coiling of her body, into a large heap which she completely covered in such a manner that the weight of the body exerted no pressure upon the soft-shelled eggs.

In order to maintain a constant temperature the snake slightly uncoiled herself from time to time, so that the eggs became visible, thus regulating the temperature.

During the period of incubation I offered ducks, fowls, and geese to the python, but she refused all nourishment.

On the 14th January she left the mass of eggs quite exposed, and I had given up the hope of a successful issue when I discovered the first nestling with half its body emerging from the egg, into which, however, it retired again towards evening.

By the next day, 15th January, six young snakes had hatched out, of which some died, while others were very active, making darts at a cloth held near them.

The period of incubation lasted exactly two and a half months.

The young measure from two to two and a half feet long, and have now been moved away from the parent into another box, where they continue to increase in size without having fed meanwhile.

Altogether forty-five young have been recovered from the clutch. Of these, thirty-six still survive, which I shall attempt to rear, feeding them with frogs and small lizards.

So far as can be ascertained, the parent python measures about 28 feet in length and weighs 250 lb.

JOHN HAGENBECK.

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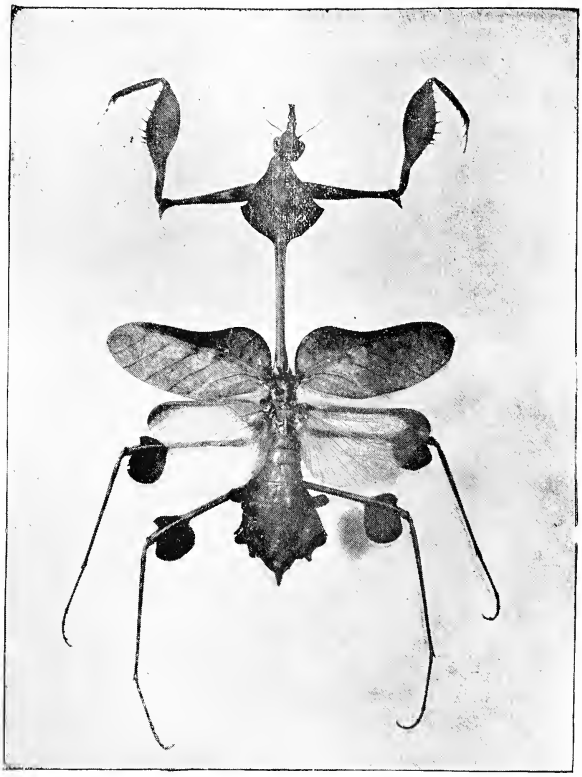
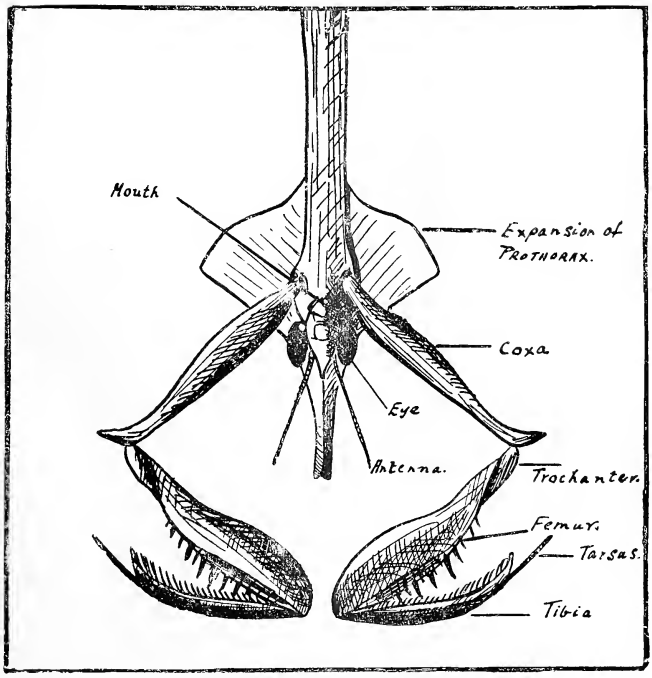
5. *Illustrations of Ceylon Orthoptera.*—With the exception of certain orders and families, the identification of insects in a Colonial Museum is always a matter of difficulty, and is frequently impossible owing to lack of the necessary literature and of material for comparison. The only way is to send collections of particular groups to be dealt with by specialists, and this is by no means so simple a matter as might appear. The figures here presented for the benefit of local readers illustrate four striking types of Orthoptera.

(1) *Gongylus gongylodes.*

The commonest in this country and the best known outside the Island is at the same time the most remarkable object in many respects. It is the Mantid insect, *Gongylus gongylodes*, the pictures of which are reproduced from an article by Mr. Percy Collins on "Flower Mimics" in "Knowledge and Scientific News," vol. I., No. 6, July, 1904, by the kind permission and courtesy of the editors of that journal.

When this insect is hanging head downwards amid foliage it is said to resemble a papilionaceous flower, the under side of the expanded prothorax being brightly coloured, sometimes nearly white with a faint bloom. It thus attracts smaller insects, which it catches with its raptorial claws. The general colour of the insect varies from green to dark brown. I have come across a specimen standing motionless like a spectre in the middle of the North road, a few miles beyond Vavuniya. In the first figure on the accompanying plates the insect is shown from above; the second figure is a diagram explanatory of the parts composing the





GONGYLUS GONGYLODES (Linn.).

(By permission of the Editors of "Knowledge and Scientific News.")

GONGYLUS GONGYLODES (Linn.).

(By permission of the Editors of "Knowledge and Scientific News.")

front end of the body seen from below. On the second plate the fore-body of the insect is represented in "flower-mimicking pose" and again with the raptorial limbs expanded to seize prey.

This insect has been known to naturalists for a very long time, having been figured by Aldrovandus in 1602, "more than a century and a half before the first appearance of the *Systema Naturæ* of Linnæus."*

It is not very rare, female examples having been found at Puttalam, at Elpitiya near Colombo, and at Kanatta. The male is however less frequently met with.

(2) *Sathrophyllia rugosa.*

The insect represented at the top of the lithographic plate is a species of Locust which has the habit of resting upon twigs, with the bark of which its wings harmonize so completely that the insect itself, although of large size, about three inches long in the body, may be easily overlooked. The long thread-like antennæ and the fore-legs are stretched out in front of the head, the middle legs hold on to the twig at the sides, and the hindmost pair of jumping legs are concealed below the wings. The prothorax is produced as a rugose crest above. The insect belongs to the sub-family Pseudophyllidæ of the family Locustina, and is named *Sathrophyllia rugosa* (Linn.).† It is to be found about Kandy and Peradeniya, where it has been taken by Mr. E. E. Green and by the writer. A specimen has also been sent to the Museum from Madulkele.‡

(3) *Phibalosoma hypharpax.*

The Stick Insect, *Phibalosoma hypharpax*, Westwood,§ shown in the middle of the plate, is drawn to a reduced scale from a female specimen nine and a half inches long sent here, alive and in the act of laying its eggs, by Mr. M. Gordon Forbes from the neighbourhood of Ratnapura last July. It is one of the longest of the Phasmidæ, a family which includes some of the largest insects that exist. The males of this genus are smaller than the females, and are provided with wings; the females are wingless.

Orthoptera in general are insects which do not undergo an abrupt metamorphosis, but gradually assume the adult form,

* For further information the reader is referred to a "Note on the Floral Simulation of *Gongylus gongylodes*, Linn.," by Dr. J. Anderson, in Proc. Asiatic Soc. Bengal, 1877, p. 193.

† *Cf.* C. Stâl, Recensio Orthopterorum, Part II. (Locustina), Stockholm, 1874, p. 70. I am indebted to Dr. David Sharp, F.R.S., for the identification of this species.

‡ Admin. Rep., Colombo Mus., 1903.

§ *Cf.* J. O. Westwood, Catalogue Orthopt. Insects, Brit. Mus., Part I., Phasmidæ, 1859, p. 175, pl. XIII., f. 6 (male).

increase in size being accompanied by periodic exuviation or casting of the cuticle. During this critical process the delicate feet are apt to be broken off, or an entire limb may be lost. When this happens the mutilated member is restored by regeneration, and the regenerated appendage always differs from a normal limb in some particulars, as for example in regard to the occurrence of spines on the femora, &c. (see figure). The most marked difference concerns the number of joints in the feet (tarsi), which are reduced by one less in the rejuvenated legs. Thus the normal number of tarsal joints in the Phasmidæ is five, the terminal joint bearing the claws and the pad, as shown in the case of the right middle leg of the figure. The opposed leg on the left side has been regenerated, and the tarsal joints are seen to be reduced to four. The same thing happens very frequently in the life-history of the leaf-insects of the genus *Phyllium*, which represents another modification of the Orthopterous type of organization.*

(4) *Teratodes monticollis.*

The last illustration is that of a remarkable grasshopper, named *Teratodes monticollis* (Gray), taken from the bund of the tank at Vavuniya by Mr. William Ferguson last July. This species is characteristic of the Northern Province of Ceylon. It was figured under the name *Gryllus monticollis*, Gray, in Griffith's Animal Kingdom, XV., pl. 64, the original locality being given vaguely as the East Indies.† It is distinguished by its stout body, short wings, short antennæ, and especially by the high crest of the pronotum, which is produced backwards beyond the insertion of the wings. It is placed in the family Pamphagidæ (Stâl, 1873) of the sub-division Acridiodea (Burmeister, 1839).

This specimen lived for many weeks at the Museum. Its prevailing colour was yellowish, like a fallen leaf, which it strongly resembles when at home in the grass.

ED., SPOL. ZEYL.

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6. *Note on Pearl Formation in the Ceylon Pearl Oyster.* (By Professor W. A. Herdman, D.Sc., F.R.S., and James Hornell.)‡—Professor Herdman and Mr. Hornell have had two cruises of

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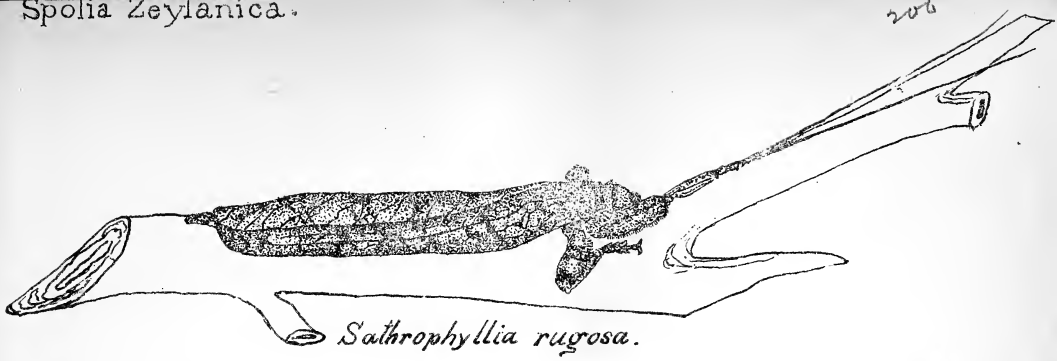
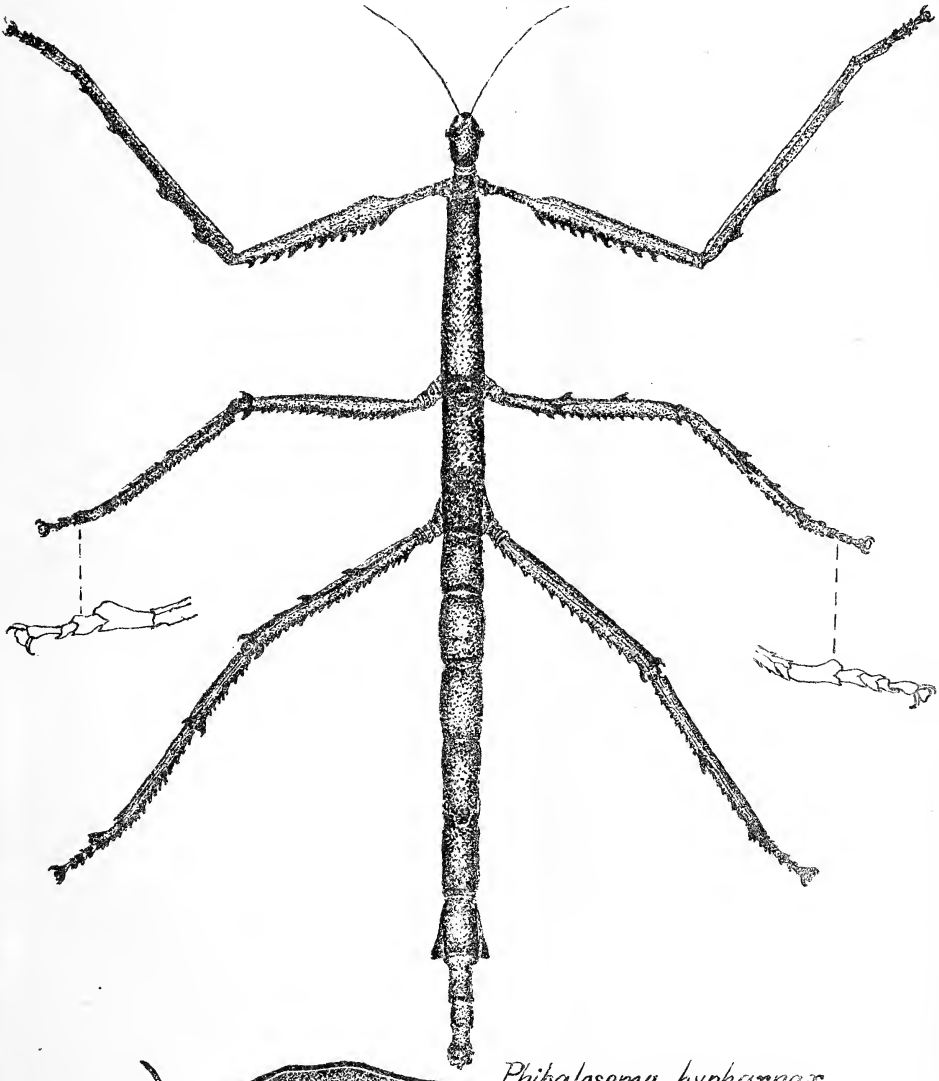
* For further information and discussion on the regeneration of lost parts in the Arthropoda, particularly in the Orthoptera, see papers by Mr. H. H. Brindley in Proc. Zool. Soc., London, 1897, pp. 903–916, and 1898, pp. 924–958, with full bibliography.

† *Cf.* H. Burmeister, Handbuch der Entomologie, Bd. II., Berlin, 1839, p. 618.

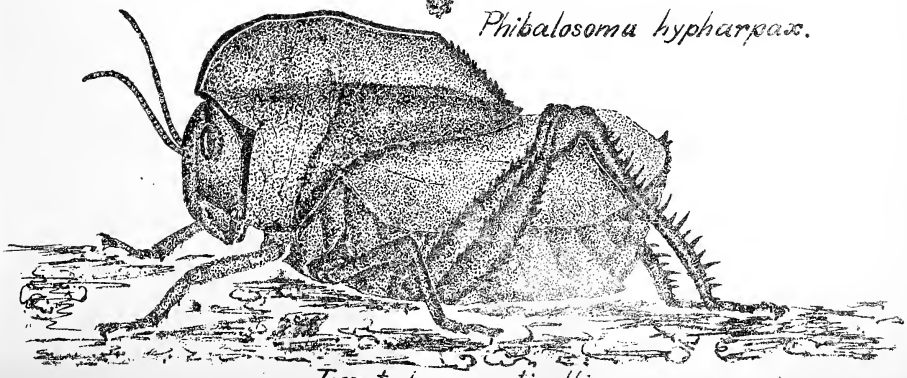
‡ Reprinted from the Report of the seventy-third meeting of the British Association for the Advancement of Science, held at Southport, September, 1903, see p. 695. The "report" is a volume of more than nine hundred pages dealing with all branches. It was published in 1904 (London, John Murray).



Sathrophyllia rugosa.



Phibalosoma hypharpax.



Teratodes monticollis.

Felix P. Candappa. del.

several weeks each amongst the pearl oyster banks in the Gulf of Mannar, and have had the experience of the three consecutive inspections of March and November, 1902, and March, 1903, and also the successful fishery of 1903, from which to draw conclusions. Many hundreds of oysters have been examined, and large numbers of pearls have been decalcified. As a result of this work they have come to the conclusion that there are several distinct causes that lead to the production of pearls in the Ceylon pearl oyster (*Margaritifera vulgaris*, Schum.).

(1) Some pearls or pearly excrescences on the interior of the shell are due to the irritation caused by *Clione*, *Leucodore*, and other boring animals.

(2) Minute grains of sand and other inorganic particles only form the nuclei of pearls under exceptional circumstances. Probably it is only when the shell is injured, *e.g.*, by the breaking of the "ears," thus enabling sand to get into the interior, that such particles supply the irritation that gives rise to pearl formation.

(3) Many pearls are found in the muscles, especially at the levator and pallial insertions, and these are formed around minute calcareous concretions, the "calcospherules," which are produced in the tissues and form centres of irritation.

(4) Most of the fine pearls found free in the body of the Ceylon oyster contain the remains of Platyhelminthian parasites, so that the stimulation which leads to the formation of an "Orient" pearl is, as has been suggested by various writers in the past, due to the presence of a minute parasitic worm. In all cases, whatever its nucleus may be, the pearl, like the nacre, is deposited by an epithelial layer.

These pearls may be conveniently classified as—

(1) *Ampullar pearls*, where the nucleus and resulting pearl lie in a pouch, or *ampulla*, of the ectoderm projecting into the mantle. The others lie in closed sacs.

(2) *Muscle pearls*, formed around calcospherules near the insertions of muscles.

(3) *Cyst pearls*, formed around encysted parasites. The parasite in the case of the majority of the cyst pearls of Ceylon is the larva of a Cestode which appears to be new, and will be described under the name *Tetrarhynchus unionifactor*.* The younger larval stages have been found free-swimming in the Gulf of Mannar and on the gills of the oyster; later stages are common

* *Cf.* The Parasites of the Pearl Oyster, by Arthur E. Shipley, M.A., F.R.S., and James Hornell, F.L.S., in Professor Herdman's Report on the Pearl Oyster Fisheries of the Gulf of Mannar, Part II., London (Royal Society), 1904, see p. 88.

in the liver, mantle, and gills; and a more advanced *Tetrarhynchus* is found in the file fishes, *Balistes mitis* and *B. stellatus*, which feed upon the oysters. The sexually mature Cestode has not yet been found, but we may expect it to occur either in one of the large Elasmobranchs (such as *Trygon uarnak*) which abound on the pearl banks, or possibly in one of the smaller cetaceans, which may also feed upon such fishes as *Balistes*.

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7. *On a Phosphorescence Phenomenon in the Indian Ocean.* (By Professor W. A. Herdman, D.Sc., F.R.S.*)—Professor Herdman described how during his recent expedition to Ceylon, as they lay at anchor in the Gulf of Mannar on 13th March, 1902, about 9 P.M., the sea was seen to be dotted with bright phosphorescent lights of considerable size, singly placed at some distance apart. These for over an hour continued to glow with a pulsating appearance *in harmony*, all shining brightly at the same moment, and then all flickering out together, to re-appear simultaneously a few seconds later. On going out at once with a net a sample of the plankton was obtained, but it was not certain that any of the pulsating forms had been caught. The gathering contained *Sagitta* (very many), *Appendicularia*, Copepoda, several common species, and *Sapphirina sinuicauda*, *Pontella fera*, *Calocalanus pavo*, and some smaller forms, along with half a dozen one-inch-long Heteronereids of a reddish-brown colour. The light was thought to be probably due to the last named, and if that is so possibly the periodicity was a result of the epitokous condition, and was accompanied by a simultaneous discharge of genital products. The matter, however, could not be made certain at the time, and the above explanation is only suggested.

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8. *On the Origin of Adam's Bridge.* (By J. Lomas, A.R.C.S., F.G.S.†)—Stretching across from the north part of Ceylon to the south-east coast of India lies a remarkable chain of low-lying islands and shallow banks known as Adam's Bridge. Rameswaram Island forms the most westerly link of the chain, and is only separated from Tonitoray spit (India) by Paumben straits, a shallow natural opening which has been deepened in parts by man. Mannar Island, at the extreme east of the bridge, lies close to the north-west coast of Ceylon. Between these a number of smaller islands

* From Rep. Brit. Assn. (Southport, 1903), p. 695.

† Reprinted from Rep. Brit. Assn. (Southport, 1903), p. 721.

complete the chain. North of Adam's Bridge extends Palk bay, a shallow mud-floored almost currentless sea, and to the south the Gulf of Mannar stretches as a low platform, deepening fairly evenly to the south at about the rate of one fathom in two miles to twenty fathoms, after which it sinks more rapidly to great depths. The platform consists of sands, which in places have been cemented *in situ* into calcareous sandstones or calcretes, chiefly by the agency of Polyzoa and Nullipores. These masses of solid rock, known as "paars," are sometimes accompanied by coral reefs in all stages of decay, from the living forms to almost structureless limestone.

In places along the west coast of Ceylon spits of sand stretch across the platform mainly near the mouths of rivers. They result from the detritus brought down by rivers, and their general trend to the north-west may be due to the combined flow of the streams and the prevailing inshore currents on the Indian side, and in Palk bay rivers form similar spits of sand which extend towards the north-east. The coasts of India and Ceylon are swept by strong marine currents running up and down the coast according to the monsoons, but owing to the longer duration of the south-west monsoon this produces greater effects, and all rivers flowing into the gulf have a tendency to extend their deltas towards the north. Near the coasts the spits consist of coarse fragments, while further out the sands become successively of finer grain. Long-continued growth of these spits would result in the formation of a platform arching to north. The rocky "paars" arrange themselves roughly into three groups running parallel with Adam's Bridge. The first line is found at a depth of $3\frac{1}{2}$ to $4\frac{1}{2}$ fathoms, the second at 6 to 8 fathoms, and the third at 9 to 10 fathoms. If an area of this character were raised above the sea level we should expect the harder "paars" and limestones to exist as islands, between which would be areas of loose drifting sand.

Such is exactly the structure of Adam's Bridge. Rameswaram Island has an ancient coral reef along its northern border, but the bulk of the island, as well as the others constituting the bridge, are composed of calcareous sandstones, like those now forming in the "paars." Similar sandstones are found all along the east coast of India from Cape Comorin to Madras, and are represented on the west coast by "the littoral concretes," which are considered by Oldham to have been originally sand spits or beach deposits. All these contain none but recent shells exactly like those living in the neighbouring seas. As no rocks of undoubted Tertiary age are found on the adjacent coasts, it would appear that all through that period the district has been in a state of equilibrium. Since

Miocene times there has been no break in the deposition of material, the new beds quietly overlapping the older. In the absence of any signs of tectonic movements during the Tertiary period we are driven to the conclusion that the shallow platform in the north part of the Gulf of Mannar is due to the filling up of the sea by the *débris* derived from the land. Suess attributes the emergence of Adam's Bridge and the "littoral concrete" to a negative eustatic movement of the sea level in post-Tertiary times. This may have been so recent that the great Hindu epic, the "Ramayana," which treats of the building of Adam's Bridge, may be a poetical rendering of events witnessed by man. Although we have no certain evidence that the bridge was at any time continuous, we have historic data to prove that the Island of Rameswaram was once united with Tonitoray spit.

If, as I suggest, the various links in the chain of islands represent emerged "paars," we have no reason to suppose, judging from the distribution of those now forming, that they were ever united.

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9. *On the oviposition and early larva of Jamides bochus*, Cram.—Peradeniya, January 6, 1905. I observed the small Lycænid butterfly *Jamides bochus*, Cram., ovipositing upon the flower buds of a species of *Vigna*. The eggs are laid—two or three together—in the midst of a small mass of colourless frothy matter which appears to dry almost immediately after extrusion. The ova are not directly attached to the plant, but rest in the midst of this cellular mass of dried froth, from which they are difficult to extricate. The egg is of a honey-yellow colour, of the usual flattened spherical form, with a median depression on what is presumably the upper surface, though the eggs lie at various angles within the mass without regard to their form. The surface of the egg appears to be minutely pitted, but it is difficult to clear away the surrounding medium sufficiently for an accurate determination of the character of the sculpturing.

On hatching, the young caterpillar emerges *outwards* through the cellular mass and bores into an adjacent flower bud, afterwards closing the aperture with a delicate (? silken) membrane, and commences to feed on the anthers of the stamens.

On its first appearance, the young larva somewhat resembles that of a Tortrix moth. It is cylindrical, pale greenish yellow, with a black head and dark brown notal plate on the second segment. There is a double median longitudinal series of small black dots, from each of which springs a longish colourless bristle. The anal segment bears an oval brown plate. Other colourless

bristles spring from minute lateral tubercles. The abdominal and anal claspers are well developed at this stage. Subsequently the larva becomes onisciform, of a pale purplish colour, the derm thickly studded with blackish tubercles surmounted by short bristles. The notal plate on the second segment is still prominent, but that on the terminal segment has disappeared. I cannot detect any dorsal gland. Such a gland, which is found on many surface-feeding Lycænid larvæ, commonly attended by ants, would be of little use on an internal-feeding species.

E. ERNEST GREEN.

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10. *Lycodon striatus in Ceylon.*—Peradeniya, January 31. A small snake, captured in a Termite's nest, has been brought to me. It at once struck me as a novelty. The coloration is somewhat like that of *Lycodon aulicus*, but differs in the more diffuse markings. The head is proportionately smaller than in the common species. Reference to Boulenger's volume (Fauna of British India, Reptilia and Batrachia) leads me to believe that we have here an example of *Lycodon striatus*, Shaw. It answers to Boulenger's description in every particular, except that it has a few pale yellow scales on the median dorsal line in the region of the three or four anterior pale bands. This colour would probably fade after immersion for some time in alcohol. Moreover, colour differences are of small importance in the determination of reptiles. My example is scarcely full grown, as it measures only eleven and a half inches, the tail one and a third inches.

E. ERNEST GREEN.

END OF VOL. II.

SPOLIA ZEYLANICA.

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